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UNIVERSITY OF ALBERTA

EFFECT OF LEXICAL SPECIFICITY ON PHONOLOGICAL RETENTION AND ITS IMPLICATIONS FOR LANGUAGE COMPREHENSION

BY

BARBARA JACENNIK

(C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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OF DOCTOR OF PHILOSOPHY

IN

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THE UNDERSIGNED CERTIFY THEY HAVE READ, AND RECOMMEND TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH FOR ACCEPTANCE, A THESIS ENTITLED Effect of Lexical Specificity on Phonological Retention and its Implications for Language Comprehension

SUBMITTED BY Barbara Jacennik

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IN PSYCHOLINGUISTICS.

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Effect of Lexical Specificity on Phonological Retention and its Implications for Language Comprehension

Barbara Jacennik

Abstract

The goal of this experimental study is to investigate the effect of the lexical variable of specificity on phonological retention within working memory. In particular, it is hypothesized that the duration of phonological retention of a word in the course of processing may depend on its specificity, defined as the ability of a word to convey information independently of context. The greater the specificity of a word, the lesser is likely to be its demand for phonological retention. Conversely, the less specific it is, the greater its use of retentional resources (Phonological Retention hypothesis).

The specificity of the lexical items used in the experiment is determined by means of a special metalinguistic task.

The study is centered around a two-task experiment. The first task, called Delayed Repetition, is a working memory task. It requires subjects to listen to and repeat a list of

sentences, one sentence behind the presentation. The second task is a Cued Recall task. Two additional metalinguistic tasks are employed in order to select and control the lexical and sentential material used in the experiment.

The crucial experimental manipulation, from the point of view of the hypothesis tested, involves interfering with the subject's ability to retain words phonologically. This is achieved by making the initial phonemes of two adjacent words in the stimulus sentences phonologically identical. The Phonological Retention hypothesis predicts that the non-specific words will be more prone to phonological interference than the specific words. This is confirmed by the results of the first task. The second task provides additional information about the effect of specificity on processing.

In addition to reporting the experimental results, the thesis contains a survey of lexical variables related to specificity and a review of the memory mechanisms involved in language processing. In the final chapter of the dissertation, the implications of the Phonological Retention hypothesis are demonstrated by showing its explanatory and predictive value with respect to a range of research issues in linguistics and psycholinguistics.

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INTRODUCTION

Language comprehension, be it spoken or written, is an everyday activity. Despite its importance, the psychological and linguistic processes involved in language comprehension are not yet fully understood. One aspect of this problem -- the effect of a lexical variable called "specificity" on the need for phonological retention in the course of utterance processing and the implications of this effect for language comprehension -- will be examined in this study.

The human information processing system has a limited capacity. In particular, the ability to retain meaningless items, such as letters, digits, or words before they are interpreted, is constrained by the processing capacity of the phonological retention component of the operational memory system, the so-called "working memory".

The phonological retention component of the working memory constitutes a real needle's eye through which most of the information-bearing words have to pass in the course of utterance interpretation. The capacity of this system is limited; depending on the availability of attentional resources, the phonological retention system may hold anywhere from 2 to 9 items (Miller, 1956; Baddeley & Hitch, 1974).

The overflow of the phonological retention system and the subsequent loss of information are most likely to occur when words cannot be processed and interpreted individually and, instead, have to be stored before they can be interpreted in each other's context. The inability of words to be interpreted in isolation is common in natural language and is known as "contextual dependency".

Numerous experimental studies have addressed the issue of the effect of polysemy and generality of words on processing. The study presented here examines the possibility that much of the processing difference among words can be explained in terms of one global, metalinguistic variable -- "specificity".

Specificity, or interpretability, is defined as the degree to which a word can convey information, be interpretable, and can thus constitute an utterance by itself, without prior interpretation of the surrounding context. The extent to which a word can be interpreted in isolation depends on how much information about the final message of the utterance can be extracted from it; in other words, how well the meaning of the utterance can be predicted from it. If specificity is defined as the ability of a word to convey information, be interpreted, independently of context, it is the opposite of contextual dependency.

An important theoretical assumption underlying the concept of specificity is that it is intuitively accessible to all native speakers of a language and that, in fact, making judgments about specificity of words and sentences is a basic psycholinguistic skill exercised by language users on an everyday basis. The specificity of the lexical items used in the experimental part of the study was established operationally by means of a metalinguistic task. The instructions to subjects performing the task were deliberate in avoiding an explicit definition of specificity. Instead, the subjects were prompted to use their own intuitive notion of specificity.

The possibility that there is a correlation between lexical specificity and the use of phonological retention in the course of language processing is the hypothesis tested in the experimental part of the study. In particular, it is proposed that words of different value on the dimension of specificity pose varying demands on the phonological retention system; this in turn creates differences in the processing ease or difficulty observed among words.

The general intention behind the study was a search for one simple basic mechanism that would account for the differences observed in the processing of words in a variety

of tasks. It is postulated that phonological retention is such a mechanism. The operation of this mechanism is assumed to be uniform in all processing situations. The observed differences in performance are attributed to the differences among vocabulary items themselves. As will be argued in Chapter 4, in the case of some words, not all stages of the word interpretation process tend to be completed in the alloted time. Whether or not a word will be fully interpreted can, to some degree, be predicted on the basis of the semantic and syntactic characteristics which determine its effectiveness as an information-bearer.

The approach in which the observed differences in performance are attributed to diversity in the lexicon, rather than to diversity of mental mechanisms, has an important theoretical advantage over the one in which the differences in performance are attributed primarily to the differences in the functioning of the hypothetical mental mechanisms, such as "access routes", "storage buffers", "stacks", "bins", often used in the literature as explanatory deviced. While it is difficult to study directly the structural and operational characteristics of neural structures, words can be examined relatively easily; their contextual distribution, frequency, associative values, imagery/concreteness values and other characteristics are readily available.

The empirical question of the interaction between phonological retention and lexical specificity is set against a larger problem of language comprehension. Since language processing is an integral part of language comprehension, the adoption of some broad view of the latter seems methodologically appropriate. The proposed model of language comprehension, explained in detail in Chapter 2, assumes that the primary function of comprehension is the recovery of information about specific entities and events. The default type of comprehension is assumed to be the "specific" comprehension.

My initial interest in language processing came from observations of aphasic patients in a clinical setting. One aphasic disorder, Broca's aphasia, attracted my attention to the role of the phonological retention in language processing. In this disorder, the deficit in phonological retention, manifested by reduced short term memory span, is accompanied by language processing deficits affecting different types of vocabulary items to a varying degree. The deficit affects function words (articles, prepositions and pronouns) more strongly than content words (nouns, verbs, adjectives and adverbs). This correlation of deficits provides evidence that some types of lexical items may impose greater demands on phonological retention than others.

The model of comprehension proposed as a framework for the experiments is shown to have very general implications for phenomena in which language processing plays an important role. Among other phenomena, it provides an explanation for the cluster of symptoms in Broca's aphasia and for the common comprehension errors in normal speakers. It also allows us to make predictions about the word order tendencies in languages in general.

The allocation of material into chapters in this study is the following. Chapter 1 discusses the memory mechanisms underlying language processing and introduces the concept of phonological retention. Chapter 2 presents the view of language comprehension proposed as a framework for the experimental part of the study. Chapter 3 surveys the various lexical variables found in the psychological and linguistic literature and introduces specificity, the lexical variable which is at the centre of the theoretical and experimental claims made in the study. Chapter 4 specifies the experimental hypotheses and discusses the theoretical and empirical arguments that led to their formulation. Chapter 5 describes the experimental procedure used, reports the results, and provides the interpretation of these results. Chapter 6 spells out the theoretical implications of the study. It is followed by the final section, Summary and Conclusions, in which the major results and conclusions are summarized.

CHAPTER 1: SHORT TERM MEMORY AND WORKING MEMORY

Studies of normal speakers

The development of a concept of working memory, assumed to be the operating system underlying reasoning and language processing, is partially due to earlier research on the concept of short term memory (STM). Since some aspects of STM are incorporated into the working memory system, it seems appropriate to start the discussion of working memory with the description of the theory of STM.

Short term memory is a theoretical construct derived from the results of simple memory span experiments. In a typical STM experiment, subjects are presented with a list of digits, letters, or words. After a retention period, usually filled by some other task, subjects are asked to recall the experimental items. The instruction may stipulate that the subjects retain the original order of presentation (fixed order recall) or recall the items in any order (free recall).

It is important to note that STM is not the only memory mechanism assumed to be involved in any such task. Crowder and Morton (Crowder & Morton, 1969; Crowder, 1970) postulate that there are at least three types of storage involved in verbal STM tasks: precategorical acoustic storage (PAS), postcategorical storage or rote memory (the STM itself), and long-term memory (LTM) storage. These roughly correspond to

three types of coding processes: sensory (echoic memory), phonological, and semantic.

The retention of information in a precategorical form was studied, among others, by Massaro (1970; 1972). In a serious of experiments in which the subjects had to identify tones as low and high before they were masked by another tone, he established that preperceptual information is retained only for about a quarter of a second. The PAS capacity is believed to be restricted to one item (e.g., a word or a syllable; Crowder, 1976), which is displaced from PAS on the arrival of any following speech item (the "suffix effect"; Crowder & Morton, 1969). Thus, in the period of about a quarter of a second, the sensory stimulus has to be identified in terms of its component sounds and copied as a perceptual unit of some sort into another type of memory, which in the case of phonological information is most likely to be the STM.

The evidence that STM is based on a phonological (acoustic or articulatory) code comes from the acoustic (or phonemic) similarity effect. The effect was first demonstrated by Conrad (1964), who, using a serial recall paradigm, found that recall confusions generated by the same letter (following a visual presentation) correlated with auditory confusions when subjects heard the letters against white noise. This effect was replicated in a number of studies: Conrad, Freeman,

& Hull, 1965; Conrad & Hull, 1964; Baddeley, 1966; Baddeley, Thomson, & Buchanan, 1975; Hintzman, 1967; Wickelgren, 1965, 1969. The same effect was also demonstrated for words with a few identical phonemes (Baddeley, 1966).

An important concept associated with STM is rehearsal. The role of rehearsal is to maintain the phonological information in short term memory (Seamon, 1980). In addition to maintaining the information in STM, rehearsal is believed to play an important role in transferring information from STM to LTM (Estes, 1972; Seamon, 1980), either by itself (Montague, 1972) or by means of facilitating various coding processes[1]. The role of rehearsal appears to be less important for concrete easily imagable words as evidenced by better performance on these items in short term memory tasks than for less concrete or less easily imagable ones (Paivio, 1981).

The claim for the articulatory character of rehearsal is supported by numerous studies. The evidence comes from at least three different lines of research: (a) articulatory suppression experiments, (b) developmental studies, (c) studies of congenitally deaf individuals. In STM experiments with induced articulatory suppression (Hintzman, 1967; Murray, 1967, Peterson, 1969) subjects have to repeat a syllable, a

---

[1]This is also known as maintenance and elaborative rehearsal (Seamon, 1980).

simple word (e.g. "the"), or count while performing the memory task. It has been shown that under such a condition the memory recall is impaired. Other evidence comes from developmental studies. It has been shown that the STM recall of six- and seven-year-old children depends on whether or not they are able to rehearse overtly. Children who repeat (as determined by observation of the lips) have been demonstrated to have better recall than have nonrepeaters. Also, when the nonrepeaters were taught to repeat, their performance improved (Keenay, Cannizo, & Flavell, 1967; Flavell, 1970). There is also some evidence based on the performance in short term memory tasks of congenitally deaf individuals. It has been found that their STM span is shorter than the span of hearing speakers, and also that there is a disassociation of performance within the deaf group, showing that the better speaking individuals also have a longer memory span.

In the mid-seventies the concepts of STM and LTM were reformulated. Instead of assuming two separate memory stores, one for STM and one for LTM, the activation of information in LTM is assumed to be equivalent to copying it into STM (Shiffrin, 1975). Further reformulation of the STM concept came with the study of Baddeley and Hitch (1974). Their experimental and theoretical work established a clear link between the STM, as defined on the basis of memory span tasks,

and the memory mechanisms in natural language processing tasks, such as verbal comprehension and reasoning.

Baddeley and Hitch ran a series of experiments addressing the relationship between performance on STM tasks and performance on more natural linguistic tasks. In particular, they tested the effects of a memory preload (series of digits), concurrent articulation, and phonological similarity on the performance in reasoning, language comprehension, and free recall. All these experimental manipulations were effective, thereby indicating that some memory mechanisms underlying these processes are STM-like in nature. To mark the distinction between the STM whose main function is assumed to be the retention of information by means of rehearsal, and the memory whose function is the processing and integration of information, Baddeley and Hitch called the newly defined memory system -- the working memory.

The theory proposed by Baddeley and Hitch assumes that working memory (WM) is an operating system consisting of a Central Executive and a STM component. The Central Executive is responsible for the retrieval, processing and integration of information. Processing is perfomed by means of subjecting the material in storage to processing by various routines. The STM component is a buffer in which the material currently being stored is processed. This part of working memory has a

variety of names, each reflecting a different aspect of its operation: articulatory loop (on the analogy with articulatory rehearsal or subvocalization), response buffer (e.g., Hitch, 1980, Baddeley et al. 1981), or phonemic buffer.

An interesting feature of the STM component of WM is that it shares most of its processing resources with the Central Executive. What this means is that the more resource-consuming the processing, the fewer items can be held in the buffer at any one time; the less resource-consuming the processing, the more resources can be reassigned to storage. The second important claim made by Baddeley and Hitch is that the sharing of resources is not absolute. Not all of the resources can be traded between the two resource-consuming components of working memory. Baddeley and Hitch observed in the course of their experiments that the subjects were usually able to hold two or three items from the preload list without a decrement in either the verbal reasoning or language comprehension tasks (Baddeley & Hitch, 1974). This demonstrates that at least some of the resources are exclusively assigned to either storage or processing and cannot be reallocated to the other component.

The Baddeley and Hitch finding that the resource-consuming processing drastically reduces the ability to retain unintegrated words or digits has some important implications

for models of language processing. In particular, it appears that, for efficiency reasons, any such model should keep the number of unintegrated, uninterpreted lexical items that have to be retained at any given moment at a minimum; if the Baddeley and Hitch results are taken as indicative of a normal language processing performance, this number should be around three. If the processing cycle can be completed without storing more than three items at any given time, the whole processing should be at its most efficient. Beyond that the processing is likely to become inefficient since the storage mechanism starts to call upon the resources normally assigned to processing, thereby making the performance of the processing component either slower or more prone to errors.

An earlier and often neglected source of information on the interaction between STM and language processing is the once popular studies on subvocalization. This was a line of research mostly ignored in the current discussions of STM and WM because of its behaviouristic tendency to reduce the mental processes to behavioural responses. The studies in question (e.g., Sokolov, 1972; McGuigan, 1978) sought to correlate cognitive activities involving inner speech (for example problem solving or calculating) with electromyographic responses in speech muscles. It appears that the measurable subvocalization observed in these studies and the neural activity underlying the operation of the articulatory loop

of the WM may be one and the same process, differing only in intensity.

Yet another source of evidence for the role of the STM-component in higher level cognitive activities is the research in the area of reading. Particularly relevant here is the evidence for the use of "speech recoding" (subvocalization under a different name) in reading (Kleiman, 1975). There is evidence that the amount of speech recoding increases in the reading of difficult texts (Edfelt, 1960; Hardyck & Petrinovich, 1970). Also, some researchers were able to correlate some reading impairments with the inability to subvocalize (Marshall & Newcombe, 1973; Shallice & Warrington, 1970).

In addition to the earlier studies of the role of subvocalization in reading, there have been recently some studies on the participation of both the storage and processing component of working memory in reading. Daneman and Carpenter (1980) found that the size of working memory span in their subjects, as assessed by means of a reading span test, was correlated with the subjects' reading comprehension performance established by several measures of reading comprehension. Daneman and Carpenter (1983) used sentences containing homographs and homonyms as target words. The sentences were presented one word at a time on a computer

screen. The time spent on each word by the subject was recorded as a dependent measure. The results showed that subjects with greater working memory capacity, measured again by the reading span test, were more likely to resolve temporary ambiguity than those with shorter spans.

Studies of STM in language-impaired

The most striking data on the importance of STM in any verbal behaviour comes from the extensive research in the area of aphasiology. Numerous studies have shown that language impairment is usually accompanied by a STM deficit. In an attempt to explain the nature of the short term memory breakdown in aphasia, different aspects of this impairment have been studied; some attempts have even been made to differentiate the aphasic syndromes in terms of the STM deficit. More importantly however, from the point of view of the current study, a number of studies have addressed the issue of the link between the short term memory deficit and the impairment of comprehension. The first part of this review will be devoted to the studies of the short term memory deficit in aphasics and the latter to the research focusing on the relationship between the STM deficit and impairment of comprehension. As it happens, the studies in the first group are based on multi-subject experiments while those in the second group are single case studies.

The multiple-subject experiments usually involve at least two groups of subjects: aphasics and normal controls. In some experiments, aphasics are subdivided further into groups according to the type of aphasia (e.g., Broca's, Wernicke's, and conduction aphasics). In some studies the researchers contrast the performance of fluent and non-fluent aphasics (for example, Wernicke's and Broca's). In addition, more than one non-aphasic group is sometimes included, for example, right-brain damaged non-aphasics and Korsakoff amnesics. While the studies reported here do not allow us to draw firm conclusions about the differences in short-term memory deficit among the different aphasic groups, the character of this deficit in aphasics in general can be inferred.

One of the first studies to address the issue of short term deficit in aphasic patients was conducted by Goodglass, Gleason, and Hyde, 1970. In this experiment, subjects were presented with a series of words and then asked to point to pictures corresponding to those words in the same order. On this task, the Broca's aphasics' performance was poorer than that of all other aphasic groups. Goodglass and his associates conclude that a production deficit is an underlying cause of this differentiation of performance -- "it is necessary to reproduce, at an inner level, the words just heard in order to point to them in the correct order." (Goodglass, Gleason, & Hyde; 1970, p.605). A similar technique was employed by

Albert (1976). Although overall performance of aphasics was poorer than that of normals, the differences among groups of aphasics were not significant.

Heilman, Scholes, and Watson (1976) used an experimental task consisting of immediate repetition of a series of digits. The aphasics' level of comprehension was tested separately. Aphasics' performance on the repetition task correlated well with their comprehension level. No significant difference between Broca's and conduction aphasics was found. The authors interpreted their results as pointing to an overt or covert repetition impairment.

Cermak and Moreines (1976) used a task in which subjects were asked to detect repetitions of different kinds (words, phonemes, rhymes, or words belonging to the same semantic category) in auditorily presented material. This task was sensitive to the type of brain damage and significant differences between groups (aphasics, right-brain damaged non-aphasic, Korsakoff amnesics, and controls) were found. These differences, however, were evident only after two words intervened between the critical items. Aphasics' performance was worse than that of normals at two intervening items, and worse than all other groups at three items. In a modified version of this experiment, Cermak and Moreines varied the rate of presentation of the lists of words. The aphasic

subjects clearly improved, and the repetitions, even after four intervening items, approached normal. There was one exception, however: with the rhymes, the effect was minimal. In Cermak and Moreines' view, these results indicate that aphasics' working memory is inferior to the memory of the patients whose primary diagnosis is amnesia.

Locke and Deck (1978) tested aphasics' memory for a series of pictures. In a pretest, they controlled the subjects' ability to retrieve the names of the words with which they were later presented in the memory task. The net gain from rehearsal -- shown by the results on the list of words that the subjects were able to name -- was negligible. Locke and Deck suggested that aphasics' poor performance was caused by a verbal rehearsal deficit aggravated by word retrieval problems.

Rothi and Hutchinson (1981) used a version of the Brown-Peterson task. This task consists of a recall following an auditory presentation of words and a distractor task (rote counting). The subjects were divided into two groups: fluent and non-fluent. The performance of non-fluent aphasics, in contrast to the fluent ones, did not show significant differences between distractor and non-distractor conditions. This was taken to indicate that the non-fluent aphasics did not rehearse the material.

Cermak, Stiassny, and Uhly (1984), in an experiment similar to Cermak and Moreines (1976), confirmed aphasics' impairment on rhyme detection. It is suggested that the impairment is due to a "reconstructive retrieval deficit" in the free recall portion of this task. In the same article they report on the results of an experiment involving controlled encoding and a following recognition of the previously encoded material. In this task, the aphasics were better on words analyzed semantically than on those analyzed either phonemically or graphically.

Ostergaard and Meudell (1984) carried out a series of three experiments. The first experiment involved repetition and recognition of words. Broca's and Wernicke's aphasics showed reduced immediate memory span. Although there was no overall difference between the two groups, there was a difference in terms of intertask correlations. While there was an intertask correlation for Broca's, there was no such correlation for Wernicke's. In their second experiment, Ostergaard and Meudell presented the subjects with a supraspan series of words and later asked them to recognize the words. A primacy effect was found for Wernicke's but not for Broca's subjects. This result is attributed to a "selective disturbance of covert rehearsal processes". The third experiment by Ostergaard and Meudell involved recognition of

photographs. In this task, Broca's had fewer correct responses than normals. As it is often assumed that verbal mediation plays a significant role in memory for visually presented nonverbal material (e.g., Kelter et al., 1977), the Broca's impairment in their immediate memory for faces was also attributed to the deficiency in verbal rehearsal.

In summary, the aphasic language impairment (the Broca's type in particular) appears to be characterized by a deficiency in verbal rehearsal. This is shown best in the tasks requiring memory for serial ordering of items and the tasks requiring memory for unrelated items (e.g., lists of digits or words). These skills appear to depend on the ability to rehearse verbally. In general, this deficit may hinder performance in any tasks requiring language-based manipulations within the working memory.

The first single case study to suggest that STM deficit may lead to impaired comprehension was conducted by Saffran and Marin (1975). Their suggestion was based on data collected from a patient who had difficulty repeating sentences, particularly long or reversible ones. Another study to pursue the same path was that of Caramazza, Basili, Koller, and Berndt (1981). Caramazza et al. studied the performance of a patient with a repetition deficit whose comprehension of individual words was relatively unimpaired while his

comprehension of sentences was poor. They included in the battery of tests used in their study the Token Test, a particularly interesting test from the point of view of the relationship between STM and comprehension. In this as well as other studies (Shallice & Warrington, 1970; Basso, Spinnler, Vallar, & Zanobio, 1982), it has been demonstrated that patients with short term memory deficit are typically impaired in recall on long and complex sentences in the Token Test.

A line of reasoning contrary to the attribution of comprehension problems to STM impairment is represented by Caplan, Vanier, and Baker (1986) who argue that comprehension deficits of short-term memory patients should be interpreted as a result of a deficit in syntactic processing independent of the STM deficit. A similar opinion is held by Butterworth, Campbell, and Howard (1986) who conducted a study of a developmental dyslexic subject with a digit span of four items and, as they claim, with a normal comprehension. Butterworth, Campbell, and Howard go as far as to suggest that STM is not necessary for auditory comprehension.

The theory that syntactic deficit is a primary cause of comprehension impairment, independently of a STM deficit, is strongly argued against by Baddeley and Wilson (1988) who, while admitting the possibility of a syntactic deficit

contribution to comprehension problems, nonetheless point to STM as being the major cause of comprehension impairment in aphasic subjects. Baddeley and Wilson criticise the Butterworth, Caplan, and Howard (1986) study for a number of reasons. The subject on whose performance Butterworth, Campbell, and Howard (1986) based their arguments showed some unusual symptoms: with a digit span of four items she had a sentence span of ten words. The tests of comprehension used were relatively easy. The subject in question was tested many years after her injury and therefore was likely to have developed strategies for coping with her limitation.

The results obtained by Butterworth, Campbell, and Howard (1986) can be contrasted with those from the studies by Vallar and Baddeley (1984a, 1984b, 1987) and by Baddeley and Wilson (1988). Vallar and Baddeley studied a patient with a clear rehearsal (articulatory loop) deficit and thus with a deficit of phonological retention. The rehearsal deficit was established on the basis of evidence of phonological coding with auditory but not visual presentation, a pattern of behaviour consistent with the deficit of rehearsal, and on the absence of either word-length or articulatory suppression effects, both known to be associated with the use of articulatory rehearsal. As expected, both the digit span and the sentence span of this subject were impaired (3 and 7 respectively). The comprehension of this patient was impaired

but only on complex and lengthy sentences, particularly when the material required retention of more than seven words.

Although the Vallar and Baddeley results were consistent overall with the explanation of comprehension impairment in terms of short term memory deficit, the patient's comprehension problems were not as dramatic as one might have expected, given her reduced digit span. Another study by Baddeley and Wilson (1988) took up the same problem and provided more convincing results in support of the short term memory account of comprehension impairment in aphasics. Baddeley and Wilson selected a patient with a digit span of only two items and a sentence span of three words. The comprehension problems of this patient clearly increased as sentence length increased. The patient did not have syntactic processing difficulties in short sentences. He was also able to increase his reading comprehension under unpaced conditions. However, his performance was reduced to chance when sentences he could understand were lengthened by redundant verbiage. All of these clearly point to the STM deficit as a source of this patient's problems and provide evidence against the syntactic explanation of comprehension impairments in aphasics.

Baddeley and Wilson (1988) provide a following description of the role of phonological retention in language comprehension:

> It is suggested that the phonological store plays an important buffering role in maintaining strings of incoming words, pending the setting up of a more durable mental model representing the meaning of the sentence. (p. 479)

Their view is very much in line with the approach of the present study. The phonological retention is assumed to be a basic language processing mechanim, which both enables and limits the processing of language for comprehension. The strings of words in the stream of speech can be considered building blocks which have to be identified first before the meaning they carry can be extracted. In the short period before the identification of the phonological form of a word and the interpretation of its meaning, the word has to exist in some form of representation. This representation is most likely to be a phonological one.

CHAPTER 2: LANGUAGE COMPREHENSION

The function of language processing is the comprehension of utterances. The underlying memory mechanisms focused on in this study are likely to be shaped so as to best serve this function. It is thus appropriate to spend some time on a discussion of language comprehension in general. In the course of this discussion a view of language comprehension will emerge which will set the specific experimental claims advanced later in the text in a broader perspective.

The specificity of language comprehension

The bulk of everyday conversation consists of sentences with a specific reference. An important assumption made throughout this text is that one of the basic goals of comprehension can be said to be the recovery of the specific reference and the communicative intention behind an utterance. In order to establish the reference and the communicative intention of the speaker, the listener has to identify the specific persons, things, places, or actions, or more generally, the specific events or scenarios referred to by the speaker. For example, in order to fully comprehend the utterance "Someone broke the window", the listener has to establish at least the "when" and "where" of the event described in the sentence, i.e., the two elements of reference that appear to be the most important in this case. In addition to the real-world reference, the second element associated

with an utterance that has to be identified in order for the comprehension to be specific is the communicative intention. In this particular example, the world knowledge system of the speaker works to supply some likely motives that might have prompted the utterance, e.g., "the window requires fixing", and/or "we have to find out who did it". The notion of communicative intention is understood here as encompassing what is traditionally referred to as the speech act value of the utterance, along with any other pragmatic information that reflects upon the speaker's goals.

A specific spatio-temporal reference appears to play an important role even if a sentence involves a projection into the future; such projections usually involve persons, objects, or places with some reference to the present. For example, the utterance "Mary will be downtown tomorrow" will make sense for the listener only if he knows who Mary is and what city is referred to. A specific reference also appears to play a role in the understanding of sentences referring to hypothetical entities. Imaginary entities usually bear resemblance to some real referents or images of referents, e.g., "jins" or "amazons"; they can usually be related to a specific existing or historical tradition (e.g., jins - Arabic, amazons - Greek).

The suggestion that listeners tend to process linguistic utterances as specifically as possible finds support in the current theoretical and experimental work in psycholinguistics. The idea that comprehension is specific rather than general or abstract is implicit in the concept of mental models formulated by Johnson-Laird and Garnham and further developed by Johnson-Laird (Johnson-Laird & Garnham, 1980; Johnson-Laird, 1983a and 1983b). The theory behind the concept of mental models proposes that language understanding is a process of constructing mental models of situations in the course of language comprehension. In this view, a sentence is not fully understood as long as a situation it is about is not identified. When a particular reference cannot be identified, the listener arrives at something called a "semantic interpretation", i.e., a range of situations that the sentence could describe (Johnson-Laird & Garnham, 1980).

The research dealing with different aspects of language comprehension usually provides evidence that even in artificially constructed experimental situations people attempt to relate the verbal materials they are presented to some specific, real-world situations, despite the fact that by doing so they may produce responses that are incorrect from the point of view of experimental instructions. In the experiment reported in Chapter 5, the subjects interrogated after the experiment often reported very specific events which

they associated with the sentences presented to them as stimulus materials. (For example, one subject reported that the word "swimmer" was particularly easy to remember for her because her brother was a competitive swimmer.) Their associations were often in disagreement with what the sentence actually stated, suggesting that the associations of real events were often based on one or two words while ignoring the meaning of the other words in the sentence. For example, the sentence "The caretaker cheated the landlord" was frequently changed to "The landlord cheated the tenant", i.e., a sentence based on a stereotype of the relationship between landlords and the occupants of an apartment building, which in this case is the converse of what the sentence actually said. The subjects thus appeared to stereotype the content of the sentences to fit their knowledge of typical events.

Further support for the notion that subjects do in fact treat experimental materials as if they referred to real situations comes from the research into the effects of context on text comprehension. Dooling and Lachman (1972) and Bransford and Johnson (1972, 1973) conducted a series of experiments which showed that the passages presented without the original context in which they were supposed to be interpreted are very hard to understand. For example, Bransford and Johnson (1972) found that it was difficult for the subjects to interpret the sentences such as "It is better

to do a few things at once than too many" without the knowledge that the sentence comes from a description of how to wash clothes.

Another line of research also providing evidence for the claim that subjects in psycholinguistic experiments are striving to "comprehend specifically" is found in the studies of the so-called "instantiation process". Instantiation refers to the kind of interpretation process in which a general term is given a more specific interpretation on the basis of the surrounding context.

Anderson and Ortony (1975) conducted an experiment in which the subjects were presented with sentences containing a general term, for example "container". The sentences in which it appeared were either "The container held the cola" or "The container held the apples". The subjects then received both "basket" and "bottle" as retrieval cues. The results showed that "bottle" was a better recall cue for the first sentence, and "basket" for the second. A later experiment by Anderson and his associates (1976) showed that "basket" was a better cue for "The container held the apples" than "container" itself. Garnham (1979) showed also that verbs as well as nouns can be instantiated.

When the context does not restrict the set of possible instantiations, instead of instantiating a category, a set of its prototypical features is likely to be evoked (e.g., the category "bird" contains such prototypical features as "can fly" or "has feathers"; cf. Heider Rosch, 1977). In view of the thesis that comprehension is by default specific, a lexical interpretation that is a list of prototypical features, rather than a specific instantiation, can be considered incomplete.

If comprehension is specific by default, i.e., if it is aimed at the recovery of the spatio-temporal reference, the specification process is likely to start with individual expressions. Which expressions are specified and to what degree is in itself a very interesting problem. The selection of the items to be specified (i.e., related to a real-world object, person or place) and the extent of their specification is likely to depend on three factors: (a) the range of meanings of the word or words composing that expression; (b) the mental model that the listener is constructing at the moment -- the situation, scenario, or script; and (c) the relative importance that the speaker attributes to the range of potential messages behind the utterance. Let us look at some examples.

(1) a. The picture of the <u>fish</u> pleased the child.

b. The <u>fish</u> attacked the child.

(2) a. There were cookies in the container.

b. The milk spilled from the container.

(3) a. The building obstructed the view.

b. The building has to be renovated for the new president.

If you imagine each of these sentences as belonging to unrelated samples of discourse and then compare the sentences with the same (underlined) lexical items, some differences are likely to arise in the degree of specificity with which the underlined words are interpreted. The present author's intention was to construct these pairs in such a way that the interpretation of the underlined word in the first sentence be less specific than the interpretation of the same word in the second sentence. For example, the word "fish" appears to require a lesser degree of specification with, perhaps, only the prototypical semantic features accessed in (1a) than in (1b).

In summary, all the issues raised and discussed in this section centre around the claim that language tends to be comprehended specifically, i.e., speakers strive to attain real-world interpretations of utterances. In particular, it has been proposed that the concept of mental models, the

instantiation process, and the phenomenon of contextual effects have a common denominator in the idea that comprehension is specific. In addition, as a separate issue, some of the factors that may influence the degree of specification of an expression that is required for its comprehension were discussed.

The lexicon as an indexing system

The view of the lexicon proposed here is that it is an indexing system used in accessing world knowledge common to a given socio-cultural group. It is hypothesized that the mental constructs associated with the lexicon system are a subset of the mental constructs underlying the world knowledge system. A lexical unit is assumed to be a unique association of an articulatory-acoustic pattern with a selected set of indexing schemes. To use an information technology metaphor, world knowledge is compared to a database and the lexicon to an indexing/retrieval system providing access to this database. An important difference between the lexicon and other knowledge subsystems is assumed to be in the fact that the sets of indexing schemes, corresponding to individual lexical items, are assumed to be linked to the word recognition and production units.

In addition to the database/indexing system metaphor, a parallel way of looking at the indexing/retrieval function of

words relative to knowledge is that of a pointer or a switch-key. The individual words can be looked at as pointers or switch-keys with the capacity to turn on the selected regions and locations of the knowledge system. The lexical entries are just that -- switch-keys in a control panel. Once activated by an acoustic input they trigger the lexical interpretation process. In a neuropsychological sense, these entries are likely to be the acoustic-articulatory word recognition units. The activation[1] of an acoustic recognition unit may cause an activation of a location or a section of the knowledge base. Switching on of multiple lexical entries may cause activation of multiple regions of the knowledge base. In this situation, the interpretation process may involve complex computations such as forming propositions, identifying members of sets, and performing logical operations on them.

Which specific section of the knowledge system is activated is likely to depend on the history of the previous activations (frequency effect) as well as on the current state of activation of the system. If a word is processed while the knowledge system is not focused on any given knowledge item

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[1]The notion of activation originated in neuropsychological studies of the brain and is now widely accepted in cognitive psychology (e.g. Collins and Loftus, 1975). The correlations between mental activity and cortical activation are studied by numerous neuropsychological techniques, for example, by methods involving measurements of event-related potentials or regional cerebral blood flow (Albyn Davis, 1983).

or domain, it is likely to be interpreted according to its most prototypical, "dictionary" interpretation. This is likely to happen with respect to words that initialize a discourse, e.g., words in opening remarks of a speech or words in a title. On the other hand, when there is already some activation going on in the system, the interpretation is likely to be biased by whatever mental scenario is currently active (priming or context effects). Given that no discourse occurs in an absolute vacuum -- there is always some context or scenario surrounding it -- prototype interpretation may well be relatively infrequent compared to interpretation biased by a context.

The switch-key metaphor works well not only for very specific, single-meaning words but also for all non-specific words, whether they are polysemous, homophonous, or general. In the latter case, the word can be compared to a multi-purpose switch key -- one that can turn on different sections of the knowledge system at the same time. In the case of polysemous, homophonous or general words that need instantiation, multiple interpretations are likely to be created more or less in parallel. It can be envisioned that the conflicting interpretations will compete with each other with the most plausible interpretation remaining as winner.

The combination of two metaphors, "lexicon as an access/retrieval system" and "words as switch-keys", served to illustrate a hypothesis about the relationship between the lexical system and the world knowledge system. In brief, this hypothesis assumes that lexicon is a conventional access/retrieval system superimposed on the basic, logical organization of knowledge. Individual words are compared to pointer or switch-keys that can select sections of the knowledge base. In the case of words with multiple meanings, the conflicting interpretations compete with each other with the most plausible ones outlasting the others.

Fixed vs. flexible entry lexicons

The view of the lexicon as an access/retrieval system is different from a view in which the lexicon itself is accessed. The view that the lexicon has to be accessed before the knowledge system can be is an unspoken assumption of the current research on word recognition and lexical access. A recent collection of papers on spoken word recognition edited by Frauenfelder and Tyler (1987) implicitly assumes lexical access to be separate from knowledge access. The authors in this volume concentrate on the former while ignoring the latter.

Upon closer inspection the concept of lexical access appears to make an important implicit assumption. It implies

that there must be something at the end of the lexical access process that can be accessed -- the lexical entry. This leads to the view of the mental lexicon as resembling a dictionary with separate fixed semantic entries for every word. The fixed-entry lexicon is bound to be of limited use, as is an actual dictionary. Lexical entries in a dictionary rarely exhaust all the possible uses of a word. Lexical interpretations in a normal conversational setting very frequently have to go beyond the range of meanings listed in the dictionary. They have to involve some degree of creative extension, with the metaphor being the most apparent example. While a fixed-entry dictionary provides some answer to the needs of a second language speaker, it is not likely that a native speaker carries around a similar device in his or her head. In order to be functional from the point of view of the communicative needs of its users, the mental lexicon has to be a flexible computational system capable of generating novel interpretations to suit each new situations rather than a fixed-entry dictionary-like lexicon.

Mental representations

A question often recurring in psycholinguistic literature is how to represent the information structures mediating language processing. This is a very difficult problem given the fact that there is no possibility of a direct test of the validity of the proposed constructs. To avoid unnecessary

theorizing, I will minimize my assumptions in this regard. Only two kinds of mental representations are assumed to be absolutely necessary in describing the mental processes underlying language comprehension: representations of speech events and representations of non-linguistic sensory or emotional experiences. Accordingly, only two types of mental codes, linguistic-phonological and nonlinguistic-experiential[2] are assumed to be necessary in the type of language processing model proposed in Chapter 4.

The reality of the phonological, speech-based code is well supported in the literature on STM/WM (see Chapter 1). The evidence for the role of experiential codes in comprehension is provided by Johansson (1973). In a study of the meanings of the verbs "walk", "trudge", "saunter", and "march", Johansson demonstrated that behind all four of them is a strong non-linguistic factor. The technique in this experiment was the following: light-emitting diodes (LED) were attached to the limbs of actors at the joints. Films were then made of the actors performing various movements in the dark, so that the only information available came from the LEDs. This information was sufficient to enable subjects

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[2]These two codes can be contrasted with more complex linguistic codes, such as the "synthetic" code in Lachman & Lachman's (1979) terminology. A synthetic code corresponds to what linguists and psychologists often call "abstract representation", i.e. a representation independent of any sensory modality.

consistently to choose the same verbs to describe the intended movement pattern. The most plausible intepretation of the subjects' consistency in this task is that mental representations of the meanings of these verbs involved perceptual tests on the physical environment. In other words, that these representations are primarily experiential; they cannot be mediated by speech-based representations[3].

Related to the issue of the form of the basic mental code is the issue of the mental representation of a unit of meaning. It is often proposed that a single proposition may correspond to such a unit. Empirical evidence exists which supports the validity of propositions as units of representation and/or processing. For example, it has been shown that the propositional density (assessed by counting the number of propositions per 100 words of text) correlates well with the informational complexity of a text and can be used as a measure of text difficulty (Kintsch & Vipond, 1979). The usefulness of propositions as the units of representation is also argued for by Johnson-Laird (1983a).

The structure of knowledge - indexing schemes

If the lexicon is a knowledge indexing and organization system, it is impossible to talk about the lexicon without

[3]Additional discussion of the role of experiential codes in mental representations can be found in Levelt, Schreuder and Hoenkamp (1976) and Miller and Johnson-Laird (1976).

some discussion of the structure of knowledge. I will address the problem of the organization of the knowledge system by attempting to identify the major indexing/categorization schemes that are likely to underlie the organization of knowledge and thereby also its access system -- the lexicon[4].

At least two sets of primary organization schemes can be expected to underlie both knowledge and the lexicon: the first set is the information relating to physical properties of objects-in-the-world; the other is information about relationships of objects-in-the-world to human needs and goals. The first scheme involves such natural properties as spatial adjacency, co-occurrence in time, size, shape, colour, weight, texture, material etc. The second involves the relationship of a given object, place or event to human actions or goals.

The first scheme stipulates that all the objects that are physically similar to each other should be stored adjacently within the knowledge system. The second scheme requires that also the objects with a similar function be stored in the knowledge system close to each other. This may lead to some gaps, inconsistencies, or even conflicts in the

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[4]This discussion focuses specifically on the relationship between the world knowledge and the lexicon systems; the various global models of the structure of knowledge (e.g. Anderson, 1983) are outside of the scope of this discussion.

representation. An example of an area that may be affected by this is zoological knowledge. It can be predicted, for example, that knowledge about animals would be stored depending on their function relative to human needs and not just according to their physical-zoological classifications. In particular, information on domestic animals is likely to be stored more closely to each other than the information about their related wildlife cousins.

The structure of knowledge - compartmentalization

I will spend some time discussing some specific indexing schemes, especially those that are most likely to have an impact on the organization of the lexicon. In particular, I will devote some time to two of the most important lexical indexing/categorization schemes -- the indexing by function and location.

The indexing/categorization schemes within the knowledge system vary in terms of their importance for communication. Researchers in artificial intelligence, psychology, and linguistics have observed for some time now the importance of functions and goals as the organizing principles of knowledge (e.g., Abelson, 1975, Schank & Abelson, 1977). This importance can be illustrated by means of a simple mental experiment.

The purpose of the experiment[5] is to compare the effectiveness of different cues -- different indexing schemes -- in the retrieval of the mentally stored information. Let us take two different characteristics of actions, one pertaining to the function and the other to the manner in which the action is performed, and try to retrieve as many different actions using these two categorization schemes as cues. An example of a goal cue is "preparation of a meal"; an example of a manner cue is "cutting with a sharp instrument". The list which can be created with the first scheme as a cue is long and comes to mind easily: buying food, washing, peeling, shredding, slicing, frying, boiling, seasoning, tasting, preparing the table, etc. The list of activities involving cutting as a criterion component is not as easily evoked: cutting food, cutting a finger, cutting fabric or paper, cutting metal. What is striking about the two lists is that the first can be confined to one time and location, in other words to a single <u>situation</u>; the second list, the one where the manner of action is used as a cue, encompasses a variety of situations and spans a range of human activities. It appears that the retrieval with function as a cue is much easier than the retrieval using the manner of action as a cue. Intuitively, in order to retrieve all information about the

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[5] Mental experiments are often used in philosophy as a method of obtaining introspective data. In experimental disciplines concerned with cognition, this method is not so commonly used. A notable exception is Johnson-Laird (1983b).

former, one has to check a single "knowledge compartment", while to find the information about the latter, the search has to wander from one compartment to another. In sum, the grouping based on the goal of action identifies a coherent domain of knowledge and the one based on the manner of action does not.

An equally important categorization scheme appears to be the indexing by location. The knowledge about ordinary activities is to a large extent organized on the basis of location where these activities are performed. Take as illustration such conceptual oppositions as "homemaking" vs. "working"; "working" vs. "traveling"; or, "visiting" vs. "hosting". The location of the activity "at home" vs. "not at home" is crucial in distinguishing these activities.

If the function and location categorizations are combined, the "knowledge compartments" can be defined quite effectively. The domains of knowledge created by combination of the goal and location schemes are relatively specific, e.g.: "staying at a hotel", "eating at a restaurant", "visiting friends", "going to church".

A number of conceptual frameworks have been proposed in order to capture the phenomenon of compartmentalization of knowledge. Some of the mental structures proposed by these

frameworks are situations (Melchuk, 1974; Chandola, 1979), schemata (Bartlett, 1932, Rumelhardt, 1975), frames (Minsky, 1975), scripts (Schank and Abelson, 1977), scenarios (Sanford & Garrod, 1981, Anderson, Garrod, & Sanford, 1983). In what follows, I will use a superordinate term of "functional domain" as a generic name for any cohesive section of knowledge. When referring to very specific functional domains, characterized by the unity of time, place and function, I will use the terms script or scenario.

In recognition of the fact that our knowledge is anthropocentric and the human needs and goals are one of its main organization factors, I will refer to all knowledge domains as functional domains. Nonetheless, it has to be acknowledged that natural categorization, i.e., the one taking into account the spatio-temporal characteristics of objects-in-the-world regardless of their relationship to human interests, also plays an important role in the organization of human knowledge: people do recognize the animals, plants, stones and stars as entities in their own right. For the sake of simplicity, however, in this text I will refer to domains such as plant and animal kingdoms as functional domains as well.

The structure of the lexicon - contextual dependency

The division of knowledge into functional domains is to some extent reflected in the structure of the lexicon. This can be demonstrated, for example, on the basis of the distribution of senses of polysemous and homonymous[6] words. These senses are often found to belong to different functional domains. Here are a few examples:

(4)

Lexical entry	Functional domains
bat	animals, sports
bug	animals, espionage, computing
cut	health, hairdressing, film production

The tendency for the different senses of a polysemous or a homophonous word to belong to different functional domains can be explained in terms of the low plausibility of co-occurrence of the two senses in the context of the same communicative situation and hence their low confusability. It

[6]Polysemy and homophony are not dealt with separately in this section because these two phenomena are similar in the sense that both refer to words which have the same phonological form but may have different meanings in different contexts. Usually polysemy is defined as a characteristic of a word whose different senses have clearly something in common such as the two senses of the verb "introduce" in "Joe introduced Mary" and "Joe introduced a new topic". Homophony, on the other hand, characterizes words which exhibit the same phonological form but their meanings have nothing in common such as "bat" in the sense of an animal and a baseball bat. There are, however, cases for which it is difficult to say whether they are instances of polysemy or homophony, for example "cut" in "Joe cut himself" and "Joe's (hair) cut impressed Mary". Such examples are accounted best by assuming that polysemy and homophony are two extremes of a continuum.

appears that language economizes on the number of code elements, i.e., the phonologically defined words, without having to compromise the communicative efficacy.

Although functional domains may separate the different senses of a polysemous or a homophonous word to the extent that they rarely occur in the same communicative situation, this is not necessarily true for all such words. Some cases of polysemy can be clarified only by attending to the details of context and situation. In the following examples, in order to differentiate between the different senses of the word "window", one has to take the whole context into consideration.

(5) a. The builders cut the window in the wall.
(window = "hole in the wall")

b. The window was warped. (window = "frame")

c. The boys broke the window. (window = "glass")

The need to rely in interpretation of words on the sentential and situational context is known as <u>contextual dependency</u>. Under different names, it has been observed by many authors. Keenan (1978) noticed that contextual dependency is particularly strong within the limits of a syntactic phrase, a NP, VP or PP. He also observed that there is a certain directionality in the disambiguating role of the sentential context. Some lexical classes are usually the

specified while others are the specifiers; e.g., the interpretation of predicative words such as adjectives, nouns or prepositions usually depends on the interpretation of the nouns in the same constituent.

We can look at some of Keenan's examples that illustrate well the extent of contextual dependency among lexical items. The adjective "flat" takes on a variety of different meanings, depending on whether it occurs with nouns "road", "beer", "tire", or "voice". The same applies to most common transitive verbs. Their interpretation varies with the interpretation of the object noun as demonstrated in (6).

(6) "cut" - a finger
- a cake
- the lawn, hair, fingernails (=trim)
- alcohol, heroin
- working hours, production, quotas.

As we can see, in each example the interpretation of the verb "cut" is different, varying in such important characteristics as the intentionality of the action or resultant integrity of the object of the action. The same holds for intransitive verbs, i.e., their interpretation varies with the interpretation of the subject NP. Take for example the verb phrase "is running" and precede it with the NPs in (7).

(7) - animal "is running"
- watch, car
- nose
- play, exhibition.

The types of expressions whose interpretation usually depends on the interpretation of some other expressions (verbs, adjectives, prepositions) Keenan calls functions. Those types of expressions which do not depend for their interpretation on others, the definite and common NPs, are called arguments.

Schank (1972) also discusses the contextual dependencies between syntactically related items. The dependency of the meaning of a lexical item on the meanings of adjacent items is further addressed by Miller (1978), who refers to such words as syncategorematic.

The process of interpretation of utterances

Language comprehension can be viewed as a process of interpretation of a lexical string where the interpretation of every word, or, perhaps, even every morpheme, is a separate event. It is likely that already the first word or two of an utterance allows the listener to form some interpretation of the incoming message. Initially the interpretation may be very general. For example, upon hearing a fragment "Would you", the interpretation may take the form of a proposition "the speaker

wants something from me", or upon hearing "John..." it may take the form of "the speaker is saying something about John".

In the framework proposed here, it is assumed that the interpretation proceeds from general to specific, with each subsequent stage bringing further narrowing down of the set of possible interpretations, eventually allowing the listener to recover the message intended by the speaker. For example, the interpretation of the sentence "John is repairing the washing machine in the basement" may proceed in steps as illustrated in (8).

(8)

Word heard	Stepwise interpretation
1. John	"the speaker is saying something about her husband"
2. is repairing	1 + "the husband is busy over a Y requiring repair"
3. the washing	1 + 2 + "Y has something to do with washing"
4. machine	1 + 2 + 3 + "Y is a washing machine"
4. in the basement	1 + 2 + 3 + 4 + "Y is in the basement"

The stepwise interpretation does not always lead the comprehender along a straight path of narrowing approximations

of the intended message. This is best illustrated by the so-called "garden path sentences" in (9).

(9) a. The horse raced past the barn fell.

b. The teachers taught by the Berlitz method passed the test.

The readers of (9a) and (9b) soon find that the first approximation of the message, one created after reading the first few words, is inappropriate and has to be rejected. Consequently, they are compelled to start over again and begin the interpretation process from a different angle.

A slightly less dramatic but likely more common interpretation shift is illustrated by the sentence in (10).

(10) It was rumoured that the British foreign affairs minister visited yesterday the U.S. ambassador to China.

The succession of words with a geographical connotation in the sentence in (10) (British, U.S., China) causes the reader to change his or her interpretation of the sentence as he/she is trying to establish the location of the reported event.

Another telling example is the sentence in (11).

(11) A union official is angered at Premier Don Getty's failure to respond to a request to get involved in the ZFI Ltd. dispute.

Here the reader has to change his or her interpretation of the incoming message several times following the winding path of shifts in the focus of this sentence.

This account of the utterance interpretation process concentrates on the bottom-up processes going from the acoustic input to the semantic interpretation. The role of the top-down processes going from the higher to the lower level processes is likely to be in setting up expectations as to the likelihood of occurrence of messages and their components. Most likely all communication takes place in the presence of some expectations on the part of the participants as to the potential classes of messages that can be expected in a given situation. As the communicative exchange develops these expectations are adjusted accordingly. The expectations are likely to have both conceptual and lexical content. In the case of open-class words the top-down expectations are more likely to be at the conceptual level, for example, the verb "eat" may generate an expectation as to the possible class of referents to be its object. In the case of closed class words, on the other hand, these expectations could conceivably be pointing towards individual lexical items. For example, the occurrence of "if" is likely to set an expectation that "then" will follow. The verb "meet" may generate an expectation that the preposition "with" is likely to occur in the immediately following context.

The interpretation of utterances - levels of interpretation

Philosophers of language have observed that a linguistic utterance may have more than one function and be interpreted on more than one level. A number of functions have been identified. Austin (1962) and Searle (1969) for example, agree on the reality of the representational and the expressive functions; the former refers to the ability of utterances to represent propositions, and the latter to their ability to represent psychological states.

Given the multifunctionality of utterances it would be practical for the interpretation of utterances to proceed simultaneously on more than one level. This can be conceptualized as a process in which the listener is formulating questions about the content and significance of the message and attemping to answer them simultaneously by analyzing the informational input of each incoming word. The different questions can be viewed as corresponding to different levels of interpretation.

As a discussion of the number and nature of the levels of interpretation is outside the scope of this study, only a few observations about the hypothesized levels will be offered. The following levels can be suggested to be the most easily identifiable: (a) the identification of the "what for"

component of an utterance, i.e., its goal, or significance; (b) the identification of the "what about" component of an utterance involving the identification of the specific referents, time and location; (c) the identification of the "what about it" component of an utterance, i.e., the new information.

The "significance level" (corresponding to the "what for" question) pertains to the speech value of an utterance and, in English, is likely to rely strongly on the interpretation of modals like "would", "should", "can". The remaining two levels (corresponding to the "what about" and "what about it" questions) concern the extraction of the propositional content of the utterance. The difference between the two propositional levels lies in the distinction between "given" and "new" information. The "what about" level is concerned with the "given" information and is usually encoded by the subject; the "what about it" level is concerned with the "new" information and is usually associated with the predicate. Only the "given" and "new" levels of interpretation are under consideration in this study.

The interpretation of utterances - identification of referents

The specificity of comprehension assumption states that the participants in the communication process strive to identify referents and actions referred to in a sentence as

a prerequisite of its comprehension. Consequently, events likely to stand out in the interpretation process are those which lead to the identification of referents.

The referents are usually realized as NPs; e.g., "the man with a moustache", "this man", "he", "John". The identification of referents may be either immediate as is likely to be the case with referents denoted by proper names or it may proceed in steps with each word bringing in more identifying information. In the latter situation, first a more general set of referents is likely to be identified; then, with more lexical input, a more specific set; and finally, the individual referent designated. In example (8), the adjectival participle "washing" circumscribes a relatively large set of "washing things". The noun "machine" cuts out a piece of this set corresponding to a subset containing the different types of washing machines. Finally, the prepositional phrase "in the basement" points at a specific washing machine in the speaker's house.

Referent identification can also be looked at as a task of finding the intersection of sets. In the washing machine example in (8), there is a set of washing things and a set of machines. The intersection of the two gives the intended referent type. To give another example, interpretation of the expression "subway station" involves first the identification

of a set of "subway things" and then a set of "stations". Together these two sets intersect to give as a result a set of "subway stations".

The effectiveness of compound names in the identification of referents is an interesting issue for the analysis of individual lexical fields. For example, is categorization-by-material, as in the expression "rubber shoe" more communicatively effective than the categorization-by-function as in the expression "dress shoe"? The effectiveness of categorization or indexing schemes in identifying the referent for a comprehender may vary depending on the communicative situation as well as on the structure of the semantic field involved. In reference to the contribution of the communicative situation, consider the utterance in (12).

(12) Give me the green folder on the middle shelf of the bookcase.

The effectiveness of the content words in the sentence in (12) in identifying the message will depend on a variety of situational factors, the most important being: the listener's knowledge of what are the speaker's goals at the moment of speaking and the physical structure of the situation involved (here: the number of folders on the shelf, the number of green things on the shelf and the number of shelves in the bookcase).

The view of the process responsible for the identification of referents presented here is very close in its basic assumptions to the view of word meaning proposed by Olson in his cognitive theory of semantics (1970). Olson assumes that:

> ...words do not "mean" referents or stand for referents, they have a use -- they specify perceived events relative to a set of alternatives; they provide information. (p.264)
>
> Words designate, signal, or specify an intended referent relative to the set of alternatives from which it must be differentiated ... (p.264)
>
> To know the use of a word, then, is not to know only what it includes, but also what is excluded or partitioned by the word. (p.270)

If there is any important difference between the current proposal and the Olson's theory, it is in the overall perspective. The theory here attempts to explain the interpretation of utterances as a part of language comprehension process. The cognitive theory of semantics outlined by Olson takes as its starting point the notion of meaning and attempts to provide a definition of meaning such that it can be easily incorporated into a theory of language comprehension.

An important advantage in assuming comprehension rather than meaning as the primary concept is that the difficulties involved in the definition of the concept of meaning can thus be circumvented. The possible interpretations of a word,

defined as the products of its comprehension, could be considered its meaning. If meaning is no longer treated as a concept that needs to be defined, the cognitive and linguistic sciences are free to focus on the description and explanation of the process of language use, i.e., its production and comprehension.

The interpretation of utterances - interpretation prerequisites

In order to be able to better analyze the process of interpretation of individual lexical items in a sentence context, I will employ a special theoretical concept, termed interpretation prerequisite. This concept is designed to capture the relationship of specification occurring in the course of processing between a contextually variable word and other words in the sentence.

A word can be said to be an interpretation prerequisite of another whenever it specifies it in an important way. For example, the words "train" and "construction" can be interpretation prerequisites of the word "engineer", as exemplified in (13a) and (13b).

(13) a. The engineer stopped the train.

b. The engineer stopped the construction

To take another example, the word "chocolate" is an interpretation prerequisite for "bar" in (14a) but not in

(14b) where the word "corner" functions as the prerequisite for "bar".

(14) a. The man noticed a chocolate bar.

b. The man noticed a corner bar.

A prerequisite word may occur either before or after the specified word which is thus retrogressively or progressively contextually dependent (cf. "washing machine" vs. "machine for cutting bread"). The interpretation prerequisite might not be a lexical item at all but an information element present in the situational context.

A typical interpretation prerequisite will be the information specifying functional domain, referents, or time. The interpretation prerequisites of a word are likely to vary across contexts and across speakers. However, some expectations as to what type of interpretation prerequisites a word might require can be formulated.

For a large class of lexical items a prerequisite of interpretation appears to be the knowledge of a reference to a particular person. This group includes pronouns, indexical expressions, as well as nouns like: sister (of), neighbour (of), partner (of), client (of), room-mate (of), colleague (of).

Another frequent kind of an interpretation prerequisite is a setting or a scenario. Consider the examples of nouns in (15) whose senses vary depending on the scenario associated with them:

(15)

Lexical item	Setting/scenario
conductor	train, concert hall
director	film set, office
officer	military, corporation
attendant	parking lot, theatre, airplane, gas station

In each of these examples, the sense of the lexical items denoting occupation varies considerably depending on the setting or scenario in which this item is used. These examples demonstrate how important it is that the information on the setting/scenario provided in the right hand column precedes the employment of the corresponding word in the column on the left.

Summary

In this chapter, a number of claims about the comprehension process as well as about the structure and relationship between world knowledge and the lexicon has been made. In particular, it has been claimed that language comprehension is by default specific and that the general or abstract comprehension takes place only when the specific comprehension has failed. The lexicon is proposed to be a

system for accessing world knowledge rather than a separate system in its own right. In the discussion of the structure of the knowledge system, emphasis was placed on its compartmentalization and on its organization by means of categorization schemes. In the discussion of the structure of the lexicon the emphasis was on the ubiquity of contextual dependency of lexical items. Finally, in the discussion of the process of interpretation of utterances it was proposed that the interpretation proceeds simultaneously on more than one level. In addition, it was proposed that the interpretation process is likely to proceed in a step-wise fashion with every lexical item resolving some uncertainty and thus further specifying the message to be recovered. Finally, the theoretical usefulness of the concept of an interpretation prerequisite was argued for.

CHAPTER 3: RELATIONSHIP OF SPECIFICITY TO OTHER LEXICAL VARIABLES

A number of lexical variables has been identified in the linguistic and psycholinguistic literature. Among those that involve meaning (as opposed to variables such as frequency or age-of-acquisition) are: polysemy/ambiguity (e.g., Lyons, 1977, Daneman & Carpenter, 1983), superordinateness/generality (e.g., Cruse, 1986, Anderson et al., 1976), vagueness (e.g., Cruse, 1986), concreteness (e.g., Kroll & Merves, 1988), imagability (e.g., Paivio, 1971), and meaningfulness (e.g., Noble, 1952).

This chapter provides a survey of the most commonly cited lexical-semantic variables. It also introduces and defines the variable of "specificity" which is central to the experimental study described in Chapter 5. The relationships between the traditional variables and specificity are explained.

The non-semantic lexical variables such as word frequency and age-of-acquisition are likely to have an effect on the familiarity of a speaker with the phonological form of a word and therefore may affect lexical processing in the early, word-recognition stages. The lexical-semantic variables such as concreteness and imagability, on the other hand, are most likely to have their impact in the later stages of lexical processing, following the actual recognition of the word

shape. The most likely locus of their effect is the stage when a word is being interpreted and its meaning integrated with the meanings of other words.

Polysemy/ambiguity

References to polysemy and ambiguity are common in the linguistic and psycholinguistic literature. Although some authors reserve the term "polysemy" for words and "ambiguity" for sentences, others do not make this distinction and refer to "ambiguity" both in the sense of words and sentences. Since the focus here is on words rather than sentences and, following the practice in the literature, ambiguity can also be attributed to words as well as sentences, it seems practical to refer to ambiguity and polysemy as one lexical variable. This variable can be represented as a continuum with the ambiguity arising from homophony on its one end, and polysemy, in which the different senses of a word are closely semantically related, on the other (cf. note 6, p.44).

Polysemy is usually defined as the capacity of a word to be used in more than one sense or meaning (Lyons, 1977; Cruse, 1986). The identification of the different senses of a word is a complex lexicographic issue. Are the different senses of "window" (cf. example on p. 45, Chapter 2) -- "a hole in the wall", "a window frame", "a window glass" -- enough to qualify "window" as a polysemous word? When looked at from the

perspective of the major indexing schemes discussed in the preceding chapter, function and location, there hardly seems to be any difference between the three senses of "window". Perhaps if the finer indexing schemes, such as the physical shape and material, are evoked, these senses could be differentiated. But which indexing schemes are important for that particular lexical item? The function and location may, in fact, be the only relevant ones in the case of "window" -- and they appear to remain the same in all three examples. If this is the case, then "window" appears to be a monosemous word.

The notion of a functional domain along with the related concept of an indexing scheme can also be used to analyze the homophonous words at the other end of the polysemy/ambiguity continuum. This can be illustrated with the word "bat". In its one sense, "bat" belongs to the functional domain of "human artifacts"; in the other sense, it denotes a member of the animal kingdom. Just the identification of broadly defined functional domains is enough, in this case, to decide that the word "bat" has two distinct meanings belonging to different functional domains; is thus polysemous.

Superordinateness/generality

Superordinateness and its opposite -- hyponymy -- is a concept used and defined by linguists (e.g., Lyons, 1977;

Cruse, 1986). It refers to the kind of relationship that exists between lexical items when one denotes the name of a superordinate category and the other the name of a member of that category (a hyponym). Examples of superordinates and their hyponynyms are: "dog - animal", "stallion - horse", and "scarlet - red".

A variable related to linguistic superordinateness has also been used in experiments by psycholinguists studying the phenomenon of instantiation. Instantiation refers to the mental substitution of specific, contextually appropriate concepts for general concepts denoted by "general terms" (Anderson et al., 1976). An example is the substitution of "bottle" for "container" or "hammer" for "tool". These so-called "general terms" used to induce instantiation are superordinates in linguistic terminology.

Vagueness

Vagueness is a lexical variable addressed primarily by philosophers of language who, among other things, are interested in the truth-value of propositions and intension/extension of referring expressions. Referring expressions are "vague" when their domain of reference cannot be clearly identified. Scheffler defines vagueness as "an indeterminacy or ambivalence in deciding the applicability of

a term to an object" (Scheffler, 1979, p.15). A similar view of vagueness is found in Alston (1964) and Cruse (1986).

One example of vagueness is the referring expression "middle aged". It is clear that a person who is 5 or 80 years old is not middle aged. It is also clear that a 50- year-old person is middle aged. It is unclear, however, whether a 39- and a 60-year-old can be included in this category. To the extent that the domain of reference of the expression "middle aged" cannot be identified, it is a vague term in the logical sense. Another example of vagueness is the difficulty in determining the applicability of the words "city" vs. "town". Is a settlement of 50000 a city or a town? The meaning of these two terms is vague in this respect.

Concreteness

The concreteness/abstractness variable is one of the most popular lexical variables found in the psychological literature. It is usually defined in terms of closeness to sensory experience. The more a word is likely to refer to something that can be identified on the basis of sensory experience the more it is concrete. The best known definition of concreteness is found in the study by Paivio, Yuille, and Madigan (1968); it is contained in the following instructions to subjects:

> Any word that refers to objects, materials, or persons should receive a 'high concreteness' rating; any word

> that refers to an abstract concept that cannot be experienced by the senses should receive a 'high abstractness' rating,...

These instructions were used to collect concreteness ratings for 925 nouns on a 7-point scale. A more recent and larger set of ratings based on similar instructions can be found in Gilhooly and Logie (1980).

Imagability

Imagability is defined in terms of a word's capacity to arouse nonverbal images. Paivio, Yuille and Madigan, in their (1968) study of lexical variables, also collected imagability values. They found this variable to be very highly correlated (.83) with concreteness. Paivio, who is the major proponent of imagery as a psycholinguistic variable, refers to it as "the major effective psychological attribute underlying linguistic abstractness-concreteness." The instructions to subjects used in Paivio, Yuille and Madigan (1968) study contain the following statements:

> Any word which, in your estimation, arouses a mental image (i.e., a mental picture, or sound, or other sensory experience) very quickly and easily should be given a 'high imagery' rating; any word that arouses a mental image with difficulty or not at all should be given a 'low imagery' rating. (p.4)

Meaningfulness

Meaningfulness was operationally defined with an experimental task in which the subjects were asked to write as many associations to a word as they could think of within

30 seconds (Noble, 1952). The average number of associations that the subjects can come up with is the word's meaningfulness value. Meaningfulness has been found to have an effect on verbal learning and was a very popular variable in this area of research.

Specificity

Many of the lexical variables discussed in this section are highly correlated with each other as shown by a number of studies (e.g., Spreen & Schulz, 1966, Paivio et al. 1968; Gilhooly & Logie, 1980). In order to account for this correlation, a global metalinguistic variable termed specificity is proposed. The rational for proposing this variable is based on the assumption that, given the high correlation among all the lexical-semantic variables, it seems likely that the majority of subjects do not distinguish among the many variables that have been proposed. Although some of the subjects acting as raters are able to make the fine distinctions required by the instructions and distinguish, for example, between concreteness and imagability, others may respond solely on the basis of their intuitions about one global variable, thus contributing to the correlation. The very existence of this correlation, however, demonstrates that the subjects are able to discriminate words semantically on some broadly defined dimension. To capture this dimension the global variable of specificity was proposed.

It is clear that, whether in isolation or in a sentence context, concrete, imagable, unambiguous/monosemous or hyponymic/specific terms are more easily interpretable than, respectively, abstract, non-imagable, polysemous/ambiguous or superordinate ones. The ease-of-interpretation appears thus to be a common underlying factor present in all of the variables in question; it is assumed to be the underlying variable responsible for all the correlations. In addition to calling it ease-of-interpretation or interpretability, this factor was also given a special name specificity, assumed to correspond better to native speakers' intuitions than the former less natural terms.

Specificity is assumed to be a metalinguistic variable, i.e., a variable used in judging words or utterances. It is defined as the perceived ability of a word to identify the communicative purpose of the utterance or its part. The degree of specificity of a word is assumed to be directly related to the processing effort used in interpreting it. The more specific a word is, the more easily the message behind the word and the sentence could be identified; the less specific it is, the more difficulty it is likely to create in the identification of the message.

Specificity is assumed to be related to an actual metalinguistic skill that language users develop while acquiring language. In particular, native speakers of a language are assumed to be able to generate intuitions about informativeness[1] of words and sentences. It is assumed that throughout their lives speakers train themselves in extracting messages from words. Consequently, they are able to assess how large is the array of messages associated with a given word and therefore how uniquely a word identifies any given message. They are thus able to judge words and sentences in terms of their value in identification of messages.

Probably every language has a set of vocabulary items whose primary reference area is words, utterances and ideas. The set of metalinguistic words in the English language includes "concrete", "specific", "precise", "concise", "to-the-point", "accurate", "clear". Other languages may partition the same semantic field differently while having an equally well developed set of metalinguistic vocabulary items. Polish, for example, has words "konkretne"[2], "określone", "ścisłe", "zwięzłe", "rzeczowe", "dokładne", "jasne", which span the same semantic field but cover different portions of it. The

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[1]The informativeness of a word can be defined as the degree to which this word reduces the number of potential messages carried by the sentence containing it.

[2]Each word in this sequence roughly corresponds in meaning to the respective word in the English sequence above.

very existence of these meta-words in the lexicon of a language provides evidence that its speakers are likely to make judgments about the words and utterances on an everyday basis and are likely to possess very general metalinguistic intuitions about the structures of their lexicons. Characteristically, all of the metalinguistic words, whether Polish or English, appear to point to the notions of communicative efficacy and ease-of-interpretation as a common denominator. It thus appears to be the single most important semantic dimension, with the remaining ones being subordinate to it.

When selecting the key term to be used in the instructions to English-speaking judges asked to categorize words in terms of interpretability, the terms "specific" and "non-specific" were chosen, based on the assumption that they are the most natural metalinguistic expressions tapping the interpretability dimension in English. The consistency and ease with which the subjects responded to the Specificity Judgments task (described in Chapter 5) provide additional evidence for the relevance of specificity-interpretability as a global metalinguistic variable in English.

Relationship of specificity to other lexical variables

Three of the lexical variables discussed above, concreteness, ambiguity/polysemy and superordinateness/

generality appear to be most closely related to specificity and thus need to be distinguished from it. This section will be devoted to a discussion of the relationships between these three variables and specificity.

The communicative efficacy and the ease-of-interpretation of a word are likely to depend on at least two components that probably determine its ability to convey information: the extent to which a word has inter-subjectively verifiable referents and the degree of stability of its meaning across contexts and situations. The first factor can be referred to as "referential specificity" and the second as "distributional specificity".

The nearness to perceptual and expressible emotional experience is likely to be a major component of specificity because only perceptually identifiable events and expressible emotions are truly intersubjective and are easily interpretable in the course of a communicative exchange. This kind of specificity appears to distinguish the meanings of words "layer" and "level", for example[3]. "Layer" is the more specific of the two words. It can easily take on a concrete, non-metaphorical meaning. "Level" on the other hand is less

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[3]In this and the following examples, I try to use words that are as closely semantically related as possible. Such examples best illustrate the discriminating power of specificity.

specific. It can express abstract, metaphorical meanings more freely. Another similar pair is "proposal" vs. "theory". While "proposals" tend to be personal, expressed on paper, and non-divisible, all of which can be assumed to correlate with specificity, "theories" can be collaborative, do not have to be externalized, and can be divided into component "theories"[4].

While concrete words are usually expected to be specific, not all abstract words are automatically non-specific. If a word points to a narrow functional domain, it may be relatively easy to interpret even though it is not referring to something easily perceivable by the senses. For example, words such as "atom" or "photosynthesis" are both specific but not concrete.

The distributional component of specificity refers to the degree in which the word always points towards the same location in the mental representation of world knowledge; in other words, it refers to the compactness vs. distribution of the meaning of a word. Distributional specificity can be

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[4] It should be noted that intuitions about the specificity of a given lexical item, or about a contrast of two items, including the ones given as examples, are expected to vary depending on the speaker's experience with this item. The metalinguistic tests, such as the Specificity Judgments task described in Chapter 5, can provide information about a general tendency in speakers' intuitions, but cannot predict individual intuitions.

illustrated with the words "chip" vs. "crumb". Most frequent uses of both "chip" and "crumb" tend to be in reference to physical objects. Metaphorical uses aside, the two differ in terms of the variety of objects that can be called "chip" or "crumb". While "crumb" is most often used in reference to bread crumbs, "chip" can have a variety of physical realizations, e.g., computer chips, steel chips, wood chips, chocolate chips, potato chips, etc. These differences in physical realizations and the associated functional contexts demonstrate that, distributionally, "crumb" is more specific than "chip".

It should be noted that specificity, as it has been defined here, resembles concreteness and polysemy/ambiguity combined together. However, it will be argued that neither of these variables alone is as powerful in spanning the lexicon as specificity.

Concreteness captures slightly different distinctions among words than specificity. It is highly correlated with specificity but is not defined in communicative terms the way specificity is. Concreteness is a measure of a perceptual availability of a referent of a word and as such has more to do with the way things are organized in the physical world, i.e., with the structure of the external reality, than with the structure of the communicatively accessible knowledge in

the minds of the speakers. Concreteness can be used, for example, to predict that "forest" is more concrete than "fortune". It cannot be used, however, to distinguish between words with equally perceivable referents, such as the words "nun", "painter", and "officer", for example. If we look, however, at the concreteness judgments collected by Paivio, Yuille, and Madigan (1968), we find that even such words were judged by their subjects as differing in concreteness. The word "nun" (C = 6.76) was judged to be more concrete than "painter" (C = 6.59) which, in turn, was rated as more concrete than "officer" (C = 6.32). How can these judgments be explained? The explanation offered here is that the subjects in the Paivio, Yuille, and Madigan study, in absence of clear differences in terms of closeness to perceptual experience, might have based their judgments on another, more natural metalinguistic variable, that of interpretability-specificity. The word "nun" is tied to a narrower array of messages than "painter" and both "nun" and "painter" are associated with a narrower set of potential messages than "officer". Consequently, "nun" is more specific than "painter" which, in turn, is more specific than "officer". Anchoring the marked value of the variable at the high end of the scale and the unmarked value at the low end of the scale, the subjects might have judged "nun" as more marked than "painter", and "painter" as more marked than "officer" while using

interpretability rather than concreteness as the underlying dimension.

Polysemy is also highly correlated with interpretability but the correlation is a negative one. The more monosemous a word is, the more easily it can be interpreted. It can be argued that polysemy, being a theoretical linguistic rather than a natural language concept does not reflect the naive language user's intuitions the way specificity, or even concreteness, does. Associated with the notion of polysemy is an inherent theoretical assumption that different senses of a polysemous word can be identified and even counted. This assumption is bound to create problems as long as there is no single standard semantic theory. The concept of specificity does not make any assumptions about the identifiability and countability of senses. A naive language user can make judgments about relative specificity of words without prior training. The only assumption is that for each pair of semantically related words one is more specific than the other in the mind of a given speaker.

In addition, polysemy and specificity differ in one more important way. While polysemy/monosemy dimension allows us to make a distinction between a polysemous word and a monosemous one, it has nothing to say about two monosemous words. The specificity dimension, on the other hand, is assumed to

reflect the fact that no two words have exactly the same meaning; in a pair of synonyms, one will always be more specific than the other. This difference gives specificity a clear advantage over polysemy as a global lexicon-spanning variable.

The last variable that appears to be closely related to specificity and has to be distinguished from it is the notion superordinate/general. The relationship of a superordinate or general term to its hyponym is similar to the logical relationship of a set to its member. The set-member relationship is a relatively natural concept for human cognition and is likely to play a role in the structure of the mental lexicon. However, I want to argue that the set-member distinction is not as vital for the functioning of the lexicon of a language as the more basic distinction between specific and non-specific.

The lexicon is not very consistent in its assignment of names to general categories -- the domain of reference of superordinate terms appears to be a result of interaction of lexical, world knowledge, and cultural factors. The following example illustrates the fact that the apparent difference in logical generality is often better explained as the difference in specificity. In English, the general name of the category "young human" is "child". The more specific term for a "young

human under one year of age" is "baby". In Polish, the respective terms are "dziecko" and "niemowlę". It seems that the general category "child" is a relatively natural one and should thus be directly translatable. As will be shown in some examples, however, it appears that the two terms are not exact equivalents of each other and cannot be translated directly. Neither can the difference between them be explained in terms of the subordinate/hyponym relationship; it can, however, be captured on the specific/non-specific dimension. The difference that I want to point out is illustrated by the translation of "Mary had a baby" in (1).

(1) a. Mary urodziła dziecko.

b. Mary give-birth-past child

Although in the literal translation "dziecko" is translated as "child", in the stylistically adjusted translation it has to be replaced with "baby". It appears that the English term for "young human" -- "child" is more specific relative to the Polish one ("dziecko") and is not used in all instances when a "young human" is referred to. On the other hand, the Polish name for a "child under one year of age" -- "niemowlę" is more specific relative to the English term "baby" and cannot be used in all the instances where the word "baby" is used in English.

In addition to the lack of correspondence between the logical general categories and the linguistic superordinate

terms, another argument against the linguistic validity of the logical concept of general vs. individual as a lexical variable is the fact that the so-called general terms are more often than not used in natural language with a specific reference in mind. This has been studied extensively under the name of "instantiation" and has been already referred to in this text (cf. Chapter 2, p.29).

Summary

This chapter has provided a brief survey of the lexical-semantic variables that can be found in the linguistic and psycholinguistic literature. The variables of polysemy, superordinateness, vagueness, concreteness, and imagability were briefly described and placed in the context of the line of study where they were first defined. In order to explain the correlations among these variables attested in the literature, it was proposed that a single underlying variable may be responsible for all the correlations. This global metalinguistic variable, termed specificity, was defined in terms of a word's value in the identification of messages or, in other words, as its interpretability. It was argued that such variable can have more validity in relation to communication than any other lexical-semantic variable.

CHAPTER 4: PHONOLOGICAL RETENTION HYPOTHESIS

Statement of the problem

The character of the lexicon and the nature of the comprehension process are two major factors affecting the mechanisms of language processing. In particular, the importance of contextual dependency of lexical items and the specificity of comprehension has been argued for in the previous two chapters Interestingly, these two factors do not cooperate but rather oppose each other.

While the specificity of comprehension requires that every utterance be specifically interpretable -- and what better way of achieving specificity than by using words that can be immediately specified -- the widespread occurrence of contextual dependency within the lexicon makes the specificity difficult to attain because the contextually dependent lexical items cannot be interpreted specifically without the use of context.

A specific interpretation of the contextually dependent lexical items can only be achieved when their supporting context is processed. In the meantime, while the specifying information is searched for in the context, the contextually dependent lexical items can only be given a tentative, non-specific interpretation. It is interesting to note that the

need for tentative lexical interpretations in the course of sentence processing have also been observed in the area of automated language processing. For example, Hirst (1987) proposes a computational solution to this problem in the form of special sub-routines of the language processing system called Polaroid words. A Polaroid word is a procedure attached to every ambiguous lexical item that "develops" its interpretation the way a Polaroid photograph develops, in parallel with the other parsing and semantic interpretation procedures. The addition of a Polaroid word procedure prevents the rest of the interpretation process from being stalled by instances of lexical ambiguity.

The time course of spoken language processing has been addressed by Forster (1979) and Marslen-Wilson and Tyler (1980) within their respective global models of language processing. The two models represented opposing views on the controversy regarding the extent of on-line vs. off-line processing in spoken language comprehension. On-line processing is the type of processing in which phonological, semantic and syntactic processing is simultaneously performed on a word-by-word basis. Off-line processing takes place when the different stages of processing follow each other thereby requiring the support of a storage mechanism. Forster (1979), is the author of the so-called serial model of language processing, which assumes that language processing is

performed serially with syntactic processing preceding semantic processing. In Forster's view, a large part of language processing takes place off-line. Some psycholinguists (e.g., Bever, Lackner, & Kirk, 1969) have suggested an even more extreme view of off-line processing, maintaining that a clause is the primary unit of sentence perception.

Marslen-Wilson and his associates (Marslen-Wilson & Welch, 1978; Marslen-Wilson, Tyler, & Seidenberg, 1978; Marslen-Wilson & Tyler, 1980) are the authors of the "on-line interactive processing model", directly opposed to Forster's serial model of language processing. On the basis of a serious of speech-shadowing and word-monitoring experiments, they established that listeners are able to recognize a word within approximately 200 msec of its onset. This corresponds, in general, to the first two phonemes of a word. Also, by manipulating various syntactic and contextual-semantic properties of stimulus material they obtained results which led them to put forward a claim that "first-pass processing" can be performed on-line:

> ...the listener can develop at least a preliminary syntactic and semantic analysis of the speech input word-by-word as he hears it ... (Marslen-Wilson & Tyler; p.6).

They are, however, not very specific about the "second-pass", off-line processing, leading the reader to believe that, perhaps, there is not much of a difference between the "first-" and "second-pass" processing:

> ...once these obligatory ["first-pass"] routines have been performed, then the listener can have access to the analysis of the input in many different ways for many different purposes. He can, for example, disentangle the acoustic-phonetic properties of the input from the other aspects of its analysis, he can focus on the structural relations between words, and so on. (p.68)

While Marslen-Wilson's claim that language has a propensity to be processed on-line was novel at the time, too much emphasis is placed on it now. The author's intention in the current study is to bring the reality of off-line processing in language comprehension again into focus. As was argued at the beginning of this chapter, language processing cannot be both specific specific and on-line at the same time due to the widespread contextual dependency of lexical items. Since it cannot be strictly on-line, it is likely to be a combination of both the on-line and off-line processing. While on-line word recognition -- recognition of the word as a phonological entity -- is plausible, the completion od semantic interpretation usually is not. The most specific words like "hammer" or "death" are likely to be on-line, less specific words, such as "tool" or "event", are likely to be processed off-line unless there is enough specifying information provided in the prior context[1].

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[1]How much specifying information or context is needed to interpret a given lexical item is a complex issue. It depends on a number of factors, the most important of which are: general knowledge of the participants, their knowledge of each other, the goal of the utterance, and its importance.

Spoken language processing differs in important ways from other forms of language processing, such as autoamated language processing or reading comprehension. An important difference lies in the duration of the persistence of a signal in a transmission medium. In automated language processing the signal storage does not pose restrictions on processing. In written language comprehension, the signal is also relatively permanent. In speech, however, the sound wave which carries the signal is very short-lived.

A major consequence of the non-permanence of the speech signal is that acoustic cues have to be perceived and encoded into some alternate form relatively quickly. The question of the form in which the signal is stored in the course of semantic interpretation applies in particular to the previously defined (cf. Chapters 2 and 3) contextually dependent, non-specific words. As these words cannot be interpreted specifically on an ongoing basis, they have to be intercepted and stored in some temporary interpretations awaiting further specifying information.

While the reality of at least some off-line processing is relatively uncontroversial, the related problem, of how off-line processing is performed, remains still unclear. In particular, an interesting question is how this off-line processing is supported. Is phonological support necessary or

not? Can the tentative interpretation of a lexical item be retained without the storage of its phonological form, or does it have to involve the storage of the phonological (perhaps abbreviated) form of the word? A hypothesis pertaining to the form of storage of contextually-dependent, non-specific words is tested in the main experiment reported in Chapter 5.

The Phonological Retention hypothesis

The proposed hypothesis assumes that phonological retention is a necessary concomitant of the processing of contextually dependent, non-specific lexical items. In particular, the hypothesis makes the assumption that phonological retention is resorted to in all instances of processing of such lexical items when they are not specified by the preceding context. If a contextually dependent lexical item cannot be specified before the next word is heard, its phonological form is put on hold by means of the phonological retention mechanism (cf. Chapter 1) awaiting further specification. The amount of specification required for any given lexical item presented as part of an actual utterance is assumed to be determined by the mental model that the listener has to construct in order to understand this utterance. The kind of processing in which lexical interpretation is put on hold by means of the phonological retention mechanism is referred to as the off-line lexical

processing and is contrasted with the on-line, immediate processing.

This Phonological Retention hypothesis is the basis of two experimental hypotheses: first predicting that interference from phonological similarity would have a negative effect on recall, and second assuming that this effect would be greater for non-specific words than for specific words. (These hypotheses are described in detail in Chapter 5.)

The Semantic Retention hypothesis

The Semantic Retention hypothesis is the opposite of the Phonological Retention hypothesis. It assumes that contextually dependent words do not require support from phonological retention in the course of processing. Instead, they are stored in a semantic form independently of their phonological form.

A following line of argumentation can be offered against this hypothesis: The generation of multiple interpretations for contextually variable words without the maintenance of the phonological form of those words would be both risky and costly. It would be too risky because the set of interpretations arrived at by the listener before hearing the following context may not include the one intended by the

speaker -- leaving the speaker without an easy way of recovery of information. It would be too costly because the accessing of all possible, often diverging interpretations, would overly tax the processing resources of the listener.

Although no research has been done addressing directly the issue of the form of support in off-line processing, the research on ambiguity, and in particular the cross-modal lexical decision (Swinney, 1979) and naming experiments (Tanenhaus, Leiman, & Seidenberg, 1979), provides some evidence for a view opposing the Phonological Retention hypothesis. This paradigm indirectly supports the Semantic Retention hypothesis. For that reason, the cross-modal paradigm results need to be analyzed here in some detail.

A classic cross-modal experiment was conducted by Swinney (1979). Subjects in this experiment listened to a sentence while watching a screen. At certain points in the sentence a string of letters, a word, or a non-word appeared on the screen. The subjects were instructed to make a lexical decision with respect to the visually presented string. The relevant finding in this experiment was that, when the word in the auditorily presented sentence, immediately preceding the presentation of the visual material, was ambiguous, lexical decisions to words related to both senses of the ambiguous item were facilitated. This facilitation was

observed for up to three syllables after the onset of the ambiguous word; it occurred regardless of the sentence context. For example, if the crucial word in the sentence was "bug", the response to an immediately following semantically related word on the screen, for example "spy" or "insect", was facilitated. This happened whether the context in the sentence prior to "bug" favoured its "spying device" or "insect" interpretation. This facilitation disappeared if the word presented visually did not appear immediately after "bug" but a few syllables later. The cross-modal experiments are usually taken to support a claim that, for a brief time during lexical processing, all the senses of an ambiguous word are accessed, even if the context provides a strong bias towards only one of them.

The Phonological Retention hypothesis claim that all senses of an ambiguous word are initially accessed can be qualified to say that all the senses are <u>available</u> as long as the phonological form of a word is available, but only the plausible ones are <u>accessed</u> and placed in the working memory. An interpretation is assumed to be plausible if it has a high frequency of occurrence or when the context, whether prior or following, provides a bias towards it.

The result obtained in the Swinney (1979) experiment, described above, can be interpreted as follows. The reason why

there was a facilitation from the contextually inappropriate meaning of the auditorily presented ambiguous to the word on the screen occurs because the "auditory word" was still present in the phonological retention system when the "visual word" appeared on the screen. The lack of a relationship between the contextually appropriate interpretation of the "auditory word" and the word on the screen might have prompted the subject to reprocess the word in the phonological retention store simultaneously with the processing of the visually presented word. The two interpretations converged at one point resulting in the facilitation of response to the word on the screen. In the control condition, the reprocessing of the ambiguous word in the light of the word on the screen did not lead to a convergence of interpretations since the control words were not related to the ambiguous word; consequently, there was no facilitation in the control condition.

The proposed model of lexical processing

This section will present a general view of the model of lexical processing that has as one of its components the phonological retention mechanism that is the subject of the Phonological Retention hypothesis.

An important issue is the temporal relationship between the phonological and semantic phases of processing. The

proposed model assumes that some semantic interpretation emerges as soon as one or two phonemes of the word are recognized. The main difference between a phonological and a semantic phase of processing is assumed to be in the focus of attention and the degree of subjective certainty -- a "certainty tag" -- that the listener is likely to apply to each level of interpretation. In the phonological phase of processing what the listener-processor --is certain of -- is the phonological form of the word; in the semantic phase, it is the semantic interpretation of the word.

Given that speech perception is outside the scope of the present study, all that needs to be said about the initial stages of word intepretation is that the acoustic cues are matched with the sounds of the language, or in other words, "phonologically recoded". Next, these phonologically recoded portions of a message have to be translated into a "semantic message" on the basis of the information stored in the world knowledge system in the mind of the listener; this is likely to begin as soon as the initial one or two phonemes of a word are recognized. At this point the interpretation of the word and its role in the message begins. With the exception of some proper names, every word can have a number of specific interpretations. It is assumed that only the most plausible

interpretation, given the context[2], becomes consciously available in the working memory.

While the "first-pass" interpretation has already reached the working memory, the phonological form of the word is still present there. It is proposed that from this point on, the form in which the word is retained depends on the subjective certainty of the listener that his current interpretation of the word is the one intended by the speaker. It is then expected that if the "certainty tag" attached to the interpretation is high, the attention will be on the semantic rather than the phonological form. If, on the other hand, the "certainty tag" is low, the opposite is expected: the attention will be on the phonological rather than the semantic form.

The placement of the focus of attention on the semantic rather than the phonological form will cause the latter to decay. The retention of the focus on the phonological form will prevent it from decaying. This, however, will have a negative side-effect, by virtue of the principle of shared resources, on which working memory operates (cf. Chapter 1). The extended allocation of resources to the retention of the phonological form will incur a reduction of the resources

[2]It is assumed that every utterance has a context, even if it is only a situational one.

available for lexical-semantic interpretation and sentence integration.

The focus of attention on the phonological form of the item that could not be processed in the "first-pass" processing is not expected to last long. The concentration of resources on an off-line item is taking the resources away from the processing of the on-line items. This situation is justified from the point of view of the efficiency of the system, as long as there is a significant likelihood that one of the on-line items can aid in the interpretation of the off-line one. As was argued, however, in the discussion of contextual dependency (see the review of Keenan's work, Chapter 2, p.45), the contextual dependencies between lexical items are strongest within the scope of a phrase (e.g., verb phrase, noun phrase, prepositional phrase). In other words, the probability that any more spefifying information can be obtained from the immediate verbal context markedly decreases at the phrase boundry. The implications from this for the temporal course of processing are that, upon reaching the boundary of the current phrase, efficiency reasons require that the attention focus on the phonological form of the incompletely specified lexical item be removed. Once the attention is shifted away from the phonological form, its

current semantic interpretation is free[3] to integrate with the semantic interpretations obtained from other portions of the sentence.

If the current interpretation was correct, but general (e.g., "action", "state", or "relationship" -- in the case of a verb -- or "person", "object", "event", of "time span" -- in the case of a noun), the final (message level) interpretation will be an incomplete but true approximation of the intended message. If, however, the first-pass interpretation was a false interpretation that was not disconfirmed by any of the later words, the final result may be a comprehension error.

The proposed description of the course of events in lexical processing cannot be tested in this study in its entirety. The aspect which is the focus of the dissertation is the Phonological Retention hypothesis which assumes that non-specific, contextually dependent words require longer phonological retention in the course of their processing than specific words. This hypothesis is subject of the experimental investigation described in Chapter 5.

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[3]The retention of the phonological form may also function as a safeguard against a premature acceptance of a lexical interpretation as the intended one.

CHAPTER 5: EXPERIMENTS

The goal of the experimental part of the study

An important constraint on the lexical processing system appears to be the limited capacity for holding uninterpreted lexical items. Hypothetically, whenever the listener is unable to interpret a word immediately on-line, he is likely to have to hold on to it as if it was a familiar but meaningless syllable or digit. According to the STM/WM theory, these items have to be kept in a phonological retention buffer. The goal of the experimental study reported here was to verify that, indeed, the phonological buffer plays a crucial role in lexical interpretation.

Rationale of the main experiment

An experiment was designed to answer two specific questions about the role of phonological retention in lexical processing:

1 Does phonological retention play a role in lexical processing?

2. Is the role of phonological retention uniform across all vocabulary items, or is it more important for some words than for others?

In order to answer either of the questions, some control had to be exercised over the subjects' ability to retain the phonologically coded material. This was accomplished by

introducing phonological similarity into the experimental sentences. The sentences were constructed in such a way that the target word -- the noun in the subject position -- was phonologically similar to the immediately following verb. It was expected that this similarity would interfere with the subjects' ability to retain the phonological form of the target noun (cf. the discussion of the acoustic similarity effect, Chapter 1, p.43). It was reasoned that, depending on the stage of processing of the target noun at the time of phonological interference, the subject will or will not be able to recall the noun. If the subject was not able to process the target noun into some new verbal or experiential representation before having to start processing the verb, the phonological similarity should negatively affect his or her ability to recall the target noun. Conversely, if the subject had finished processing the noun by the time he/she had to start processing the verb, the phonological similarity should not have any negative effect on his/her ability to recall the target noun.

In order to answer the second question, i.e., whether the importance of phonological retention depends on the kind of vocabulary item being processed, the lexical material had to be varied in terms of some lexical variable assumed to be important for processing. As is argued throughout this text, one such variable is "specificity". It is assumed to be

related to the speaker's intuitions about the ease-of-interpretation of a word. The assignment of nouns to the categories of easy-to-interpret "specific" and difficult-to-interpret "non-specific" words was based on metalinguistic judgments of a group of subjects, described in the following section.

Although in the main experiment, the only lexical variable varied was specificity, the lexical-semantic variables related to specificity (cf. Chapter 3) are expected to behave similarly in this type of experiment. In general, it is expected that the results of this experiment can be extrapolated for all contextually-dependent, difficult-to-interpret types of words.

It is expected that, from the processing point of view, it does not matter whether or not a contextually dependent word is, in fact, specified by the following context. Whenever a word cannot be specified/disambiguated by a prior context, it is likely to be treated by the listener as if he/she expected that it will be specified/disambiguated later.

Experimental hypotheses

The following two hypotheses to be tested in the experiment were formulated:

1. It was expected that the recall of target nouns will be better in the phonologically dissimilar condition as compared with the phonologically similar condition, thus demonstrating the importance of phonological retention in lexical processing.

2. It was also expected that the effect of phonological interference, as shown by recall, would be greater for non-specific words than for specific words, thus demonstrating the varying degree of dependence of these two categories of words on phonological retention.

In summary, It was expected that the error rate on recall in the phonologically similar condition should be sensitive to the ease with which a word is interpreted and to its dependence on phonological retention.

Selection of the lexical material - Specificity Judgments Task

The abundance of meta-words, i.e., words which serve to describe words or utterances in the lexicon of a language (see examples on p. 67), suggests that speakers often make judgments about the ease-of-interpretation of words or utterances on a daily basis; they ar thus likely to possess strong intuitions about the structure of their mental lexicons. This ability was taken advantage of in selecting the lexical variables to be used in the main experiment in

order to test the second question, i.e., whether the importance of phonological retention varies with the type of vocabulary. The term specificity was chosen as a name of the variable since the "specific/non-specific" distinction appears to reflect the most general intuitions the speakers of English have about the structure of their mental lexicons.

It appears that the speakers of a language are usually quite good in tagging words as either specific or non-specific. In order to confirm the experimenter's judgments about the set of words selected for the experiment, a total of 66 university students were asked to act as judges. Their task was to assign words to either a Specific or a Non-specific category using a special form (Appendix A). The instructions (Appendix B) included the following excerpt:

> The English language has a very rich vocabulary. Different words have different meanings. Some words are specific, others are not. The word "astronaut", for example, has a specific meaning while the word "consultant" does not. The astronaut is always associated with one area of human activity - space exploration. The word "consultant" can be associated with different scenarios or settings since there can be different kinds of consultants: family, financial or computing.

With the above rather vague instructions, which basically just encouraged the use of whatever intuitions subjects may have about the specific/non-specific distinction, the subjects found it easy to make the judgments. With the exception of one word for which the agreement was slightly lower, all words

preselected by the experimenter were judged as belonging to either Specific or Non-specific category by at least 70% of judges and the majority of words was judged consistently by 90% or more. It is speculated that subjects would have yet stronger intuitions about the specificity of individual lexical items had a paired-comparison task been used -- a more natural but experimentally less practical task than the forced choice one.

Delayed Repetition task

The experimental procedure involved two separate tasks. The first task, invented specifically for this study, was dubbed Delayed Repetition (DelRep). In this task, the subjects were instructed to listen to a list of sentences coming from a tape and to repeat the sentences to a microphone connected to a second tape recorder during the 4 s of silence following each sentence. They were asked to wait two sentences at the beginning of the list before starting to repeat. Consequently, the repetitions were always delayed by one sentence relative to the presentation on the tape. Here is a relevant part of instructions to subjects (Appendix C):

> You will hear a series of sentences. I want you to wait until you have heard the second sentence. There will be a pause of about 4 seconds. This is when you are asked to repeat the first sentence you heard. After you have heard the third, repeat the second, and so on until the end of the list. In general, you are asked to repeat sentences with one sentence delay.

Cued Recall task

Following the Delayed Repetition task, the subjects were asked to do a Cued Recall task. The second task was administered approximately 5 minutes after the initial presentation of sentences in the first task. In the Cued Recall task the subjects were presented with a list of sentence fragments consisting of verbs and object nouns of the target sentences which they previously repeated in the Delayed Repetition task (Appendix D) and were asked to fill in the blanked out subject nouns.

Stimulus material

All sentences were of the same SVO structure. Each sentence was a description of a small event involving two people specified by their profession or some other characteristic. The reason why simple transitive sentences were used is that such sentences can be self-contained semantically without being too long. The sentences were as unrelated to each other as it was possible to make them while working with a narrowly defined field of nouns and verbs. The nouns were action, profession or other people-denoting terms; the verbs were interpersonal- action or attitude verbs.

The target sentences belonged to four types varied in terms of the value of the two experimental variables: Phonological Similarity and Specificity. Phonological

Similarity/Dissimilarity was defined in terms of the presence or absence of identical phonemes in the first three segments of the subject and verb. Specificity/Non-specificity was defined depending on whether the subject noun in the sentence belonged to the Specific or Non-specific category. The reason why the subject position was chosen for the target word is that in this position there is no preceding context and the difference between the items which are context dependent and these which are not is most pronounced. Here are examples of the four types of sentences:

NON-SPEC/SIMIL (NS) - The beginner believed the pilot.
NON-SPEC/DISSIMIL (ND) - The spectator believed the pilot.
SPEC/SIMIL (SS) - The balloonist believed the pilot.
SPEC/DISSIMIL (SD) - The acrobat believed the pilot

As noted above, the materials used in the Cued Recall task were sentence fragments corresponding to the sentences in the Delayed Repetition task with the subject position empty.

Subjects

Fifty six subjects participated in the experiment, 14 per experimental list. The subjects were students at the University of Alberta who were native or near-native speakers of English without any known neurological disorders and with

normal hearing (based on introspective reports). There were 28 men and 28 women. The subjects were randomly assigned to groups and the number of male and female subjects in each group was kept equal. Their age ranged from 18 to 45.

Experimental design

Each verb-object fragment yields four different sentences (as shown in the examples above). In order to avoid repetition of lexical material given to one subject, four different lists of sentences were constructed and given to four groups of subjects. For each subject the experimental treatment was the same, as everybody was presented with sentences from all four types, but the experimental materials were slightly different as each group was presented with a different set of 12 target nouns.

According to the classification used in the statistical literature (Winer, 1971; Kirk, 1982), this type of design can be classified as split plot design with two factors crossed (Similarity and Specificity) and one nested (List)

Experimental lists

The experimental lists were recorded by a speaker of Canadian English, using a good-fidelity SONY recording and playback equipment. She read the stimulus sentences taking

care to use a neutral level of intonation, unvaried across the four sentence type.

In addition to target sentences, each of the four lists contained 12 filler sentences (F). The targets and fillers were interleaved within the list so that no two target sentences occurred adjacent to each other. Also, the targets were cycled in blocks of four in order to keep the replicates of a given type evenly distributed throughout the list (see Appendix E).

The following variables were balanced across the four experimental conditions (i.e., the four sentence types): (a) sentence length; (b) number of phonologically similar phonemes in the initial syllables of subject-noun pairs; (c) word frequency; (d) plausibility of sentences used in the experiment. The sentence lengths varied between 8 and 11 syllables and were balanced across the types. The number of phonologically similar phonemes in the initial syllables of the phonologically similar noun-verb pair was always 2 out of the first 3 segments, and always included the first. Word frequency in the case of verbs and object nouns was controlled by using the same verbs and objects four times, each time with a different subject noun. In the case of subject nouns, which had to be varied as a result of the experimental manipulation,

the frequency was controlled by keeping the cumulative frequency in each sentence type constant.

Since psycholinguistic literature contains some reports of the plausibility effects which may be independent of the lexical effects (Ratcliff, 1987), an effort was made to control the potential differences in plausibility between the sentence types. The plausibility of sentences used in the experiment was controlled by verifying that their plausibility is not significantly different across different types. A special Plausibility Judgments Task, described below, was given to a group of raters to verify this. The potential differences in plausibility of the fillers which functioned as memory load during processing of target sentences was balanced by having each filler function as a memory load four times, once with each type of target sentence.

Selection of the sentential material - Plausibility Rating Task

It is a well-established finding in the psycholinguistic literature that plausible sentences describing ordinary, highly likely events such as "The doctor examined the patient" are more quickly and accurately processed than implausible sentences describing bizarre or unusual situations such as "The unicorn scared the witch".

The effect of plausibility was reported in shadowing and recall tasks (Marks & Miller, 1964; Miller & Isard, 1963; Rosenberg, 1968, 1969; Rosenberg & Jarvella, 1970), in RSVP[1] tasks (Forster & Ryder, 1971) and in a variety of reaction time tasks, including those tasks in which the processing for meaning would seem to be unnecessary, e.g., the grammaticality task, in which sentences are classified as either grammatical or ungrammatical (Forster & Olbrei, 1973, Watson, 1976) or the sentence matching task, in which sentences are classified as either physically identical or different (Murray's study, cited in Ratcliff, 1987).

In order to avoid a contamination of the experimental effects of interest by accidental plausibility differences between the four types of stimulus sentences, all sentences were rated by a group of raters who participated in a Plausibility Rating Task. Seventy two students were asked to provide plausibility judgments for the sentences used in the main experiment. The judgments were made on a 7 point scale (Appendix F) using a set of instructions (Appendix G) similar to those used by Ratcliff (1987) in his study of the plausibility effect. Since the raters were divided into four groups of 18, each group presented with only one of the four stimulus lists, it was necessary to test the correlation between different groups of judges before combining their

[1]Rapid Serial Visual Presentation

scores. This was achieved by also collecting from the judges the judgments on the filler sentences which were identical on each list.

The correlation of judgments on the filler sentences, measured by the Kendall coefficient of concordance W was found to be .88. This value corresponds to the .82 value of the averaged Spearman rank correlation cofficients between each of the pairs of rankings (Siegel, 1956); it is significant at $p < .001$ level. Such high correlation justified treating the four sets of ratings as representative of one population of plausibility judgments. The ratings from the four groups were combined and a one-way analysis of variance with sentence types as the main factor was performed. No significant effect of plausibility was found, leading to the conclusion that there was no difference in plausibility among the four types of stimulus material used in the main experiment.

Results - error types

A wide range of incorrect responses was observed in the subjects' performance on the Delayed Repetition task. The errors were classified according to two general criteria, their linguistic character (e.g., phonological or semantic), and the source of the error (e.g., preceding sentence or following sentence), when such could be determined. Below are provided the specific criteria used in isolating a given type

along with the percentage of the total errors that this type constitutes. The errors on all words, subjects, verbs, and objects, from the target and filler sentences were counted.

OMISSIONS (80.4 %)

The target word was not repeated in its proper sentence position. No other word was substituted in its place. (In this category were included both the situations in which the subject did not recall at all the sentence with the target word as well as the situations when he/she recalled part of the sentence and substituted a filler word "something" for the target word.)

EXTERNAL SUBSTITUTION - BACKWARD (7%)

The source of the substitution is in one of the preceding sentences.

EXTERNAL SUBSTITUTION - FORWARD (1.7%)

The source of the substitution is in the sentence that the subject is supposed to repeat next.

INTERNAL SUBSTITUTION (2%)

The subject noun was repeated in the object position or vice versa; for example:

The soldier photographed the tourist.

---> The tourist photographed ...

SEMANTIC SUBSTITUTION (0.9%)

The substitution provided in place of the target is a synonym or a word closely semantically related to one of the words in the target sentence; for example:

awaited	--->	waited for
detested	--->	disliked
trapper	--->	hunter

WORD CLASS CHANGE (0.5%)

The word provided in place of the target has the same stem as the target but an ending that is characteristic of a different word class; for example:

photographed	--->	photograph
dealer	--->	dealt with
cheated	--->	cheater

MORPHOLOGICAL SUBSTITUTION/DISTORTION (0.2%)

The word provided in place of the target has the same stem as the target but the ending is omitted or altered in some other way; for example:

housekeeper	--->	house
forester	--->	forest
cyclist	--->	cycler

PHONOLOGICAL SUBSTITUTION (0.9%)

The word provided in place of the target resembles the target phonologically but differs from it semantically; for example:

banker	--->	baker
protected	--->	protested
bartender	--->	barber

PHONOLOGICAL DISTORTION (0.5%)

The word provided in place of the target is a clear distortion of the target word but it does not alter its lexical identity, i.e., it does not resemble any other word; for example:

escorted	--->	excorted
journalist	--->	journamist
spectator	--->	spe...

CREATION (5.9%)

The source of the error is not clear; for example:

seduced	--->	assaulted
jogger	--->	outran
worshipped	--->	helped

PERSEVERATION (13% of non-omission errors)

This category includes external substitutions or creations that were repeated. The majority of

perseveration type errors were verbs. Some subjects repeated certain verbs as many as 11 times.

It is worth noting that in those cases when the subjects responded with a complete sentence albeit, not a correct one, the sentences were usually semantically and syntactically correct and were describing hypothetical but plausible events. The subjects often gave interpretations to sentences based on current real-world events, or on their own experiences. This suggests a tendency on the part of the subjects to process the sentences for comprehension and as specifically as possible.

It can be speculated that such specific comprehension was a strategically justified approach in this task. It appears that the subjects adopted a strategy to treat the incoming sentences as if they referred to some real but incidental information which has a practical value only during the course of the experiment but has no bearing for the knowledge in general, i.e., does not have to be transfered to long term memory.

The high percentage of omissions (80.4) as compared to other types of errors might be a result of the overall difficulty of the task and, in particular, the time constraint imposed on subjects' responses. One way to address this issue would be to conduct an experiment in which the intervals

between the presentations of individual sentences were longer. It can be speculated that allowing the subjects more time to respond would improve the overall level of performance. Whether it would result in an increase of the semantic type errors as opposed to omissions is not clear; having more time to rehearse the subjects might produce more accurate verbatim repetitions. Although an experiment investigating this issue appears to be a logical continuation of this study, the experimenters undertaking it should also answer the question whether giving the subjects additional time to rehearse would not result in a less natural language processing task.

Results - tests of the hypotheses

Since the main differences in results between the different conditions were in the repetitions or recalls of subject nouns, the main analysis was based on just these items. The responses were scored as either correct (1) or incorrect (0) where a correct response was a phonologically and semantically correct recall of the target in its proper position; an incorrect response could be any of the error types listed above. For each subject, the responses within each sentence type were totalled giving a measure of recall which varied between 0, when no subject noun in sentences of this type was correct, and 3, when all three were correct.

A considerable variation among the subjects in terms of the total target words recalled was observed. The scores for individual subjects, totalled across sentence types, varied between 8% and 83% in the Delayed Repetition task, and between 0% and 58% in the Cued Recall task. This variation did not constitute a problem from the methodological point of view as the design of the experiment involved repeated measures -- therefore each subject acted as his/her own control.

The results of the main and interaction effects from the main experiment are represented in Appendix H. As it was previously mentioned, this experiment can be treated as a split plot design with two factors crossed (Similarity and Specificity) and one nested (List). Since the designs were analogous for the Delayed Repetition and Cued Recall tasks, two independent analyses of variance were performed.

The results of the Delayed Repetition task are charted in Appendix I. In this task, Specificity main effect, $F= 7.17$, $p(1,52) < .025$ and Specificity X Similarity interaction, $F= 4.55$, $p(1,52) < .05$ were significant. There was no main effect of Similarity but this has to be interpreted in view of the fact that there was a cross-over interaction of Specificity and Similarity.

In terms of the hypotheses formulated at the beginning of this chapter (p.95), the Specificity X Similarity interaction constitutes a direct confirmation of the second hypothesis, which predicted that the effect of phonological interference, as shown by recall, would be greater for non-specific words than for specific words. The first hypothesis, which predicted that the recall of target nouns will be better in the phonologically dissimilar condition as compared with the phonologically similar condition, was only partly confirmed in this task, i.e., a negative effect of similarity was observed for the non-specific words but not for the specific ones.

To ensure that the statistical tests performed were valid, i.e., no violation of the assumptions of the analysis of variance had occurred, some steps to verify the assumptions were taken. There are two basic assumptions which have to be met in order for the F test to be accurate. These are the assumptions of normality and of homogeneity of variance. The normality assumption requires that the distribution of the measurements of the characteristic in question be approximately normal in the corresponding population. This assumption is usually not tested directly. It can, however, be verified by inspecting the frequency distribution of the experimental scores. If the type of measurement used in the experiment is known from other

research to be normally distributed, it can be assumed that the experimental samples were drawn from a normally distributed population, even if the frequency distributions from the experiments deviate from a normal distribution. In this case, the frequency distributions of recall scores appear to approximate the normal distribution (Appendix J). The measurement of recall of the type used in this experiment -- in terms of the number of correctly recalled items -- is a popular type of dependent variable in psychological and psycholinguistic experimentation. As in other experiments using this variable, it can also be assumed to be normally distributed in this experiment.

The second assumption that needs to be satisfied in an analysis of variance is the assumption of the homogeneity of variance which requires that the results assigned to any one of the cells in the experimental design come from the populations with equal variances. In the case of the experimental design used in this study, two different kinds of test were required, one for the between-blocks contrasts (where a block corresponds to the set of results from one subject) and one for the within-blocks contrasts.

The check of the homogeneity assumption that is required to ensure the validity of a between blocks hypothesis test was also conducted despite the fact that the between blocks effect

-- List -- was not of theoretical interest. The tests used for this purpose were the Hartley's Fmax test and the Cochran C test (Kirk, 1982; p.78). The values of these tests were below the critical values and hence the assumption of the homogeneity of variance between the different levels of List factor was retained.

The assumption of the homogeneity of variance when there are repeated measures, i.e., when the effects are tested within subjects instead of between subjects, is referred to as the sphericity or circularity assumption. A special verification procedure recommended by both Kirk and Winer was followed to check this assumption. According to this procedure (Kirk, 1982; p. 259), whenever a violation of the circularity assumption is suspected, a more conservative F test may be adopted by modifying the number of degrees of freedom of the required critical value of F. In the case of the between subjects contrasts tested in the present experiment, Specificity, Similarity and Specificity X Similarity interaction, both the F tests with the original and modified numbers of degrees of freedom yielded the same results, suggesting that these tests are significant, regardless of whether or not the circularity assumption was violated.

In Cued Recall, charted in Appendix I, there was a Specificity main effect, $F= 23.79$, $p(1,52) < .005$ and a

Similarity main effect, $F= 5.56$, $p(1,52) < .025$. There were also a List effect, $F= 2.88$, $p(3,52) < .05$, and a List X Similarity interaction effect, $F= 4.54$, $p(3,52) < .025$. List effects are not unusual in a split plot design. The overall depressed scores in the Cued Recall experiment as compared with Delayed Repetition (17% and 55% mean recall respectively) make the results of the second experiment a little less clear and more difficult to interpret than those of the first experiment. The exception is the very strong Specificity effect.

In terms of the hypotheses formulated at the beginning of this chapter (p.95), the Similarity main effect is a direct confirmation of the first hypothesis. The second hypothesis, which was confirmed in the Delayed Repetition task, was not confirmed in the Cued Recall task as no Specificity X Similarity interaction was found. The fact that there was no such interaction in the Cued Recall data (a difference from the Delayed Repetition data) must be interpreted in view of the fact that there was a floor effect in the two non-specific types of sentences, which might have cut off some of the low scores in these two types of sentences and wiped out a potential interaction.

As in the case of the Delayed Repetition data, an effort was made to verify whether the assumptions of the analysis of

variance were met in the case of Cued Recall. The normality assumption in this case can only be satisfied by referring to the evidence found in the experimental literature, suggesting that measurements of recall of the type used here tend to be normally distributed. The inspection of the frequency distribution of the Cued Recall task results alone cannot be used to support the normality assumption because the floor effect resulted in a highly skewed distribution (Appendix K). In order to satisfy the homogeneity of variance assumption for the between subjects List effect, the Fmax and Cochran C tests were conducted. Their values were found to be not significant. In the case of within subjects tests, as in the Delayed Repetition data analysis, the procedure to avoid the negative effects of the potential violation of the circularity assumption was followed. The results turned out to be significant even in the event of the circularity assumption violation.

Interpretation

The results listed in the preceding section can be interpreted as follows.

1. The Specificity effect in the Delayed Repetition task shows that the non-specific words are more difficult to interpret than the specific words. The difficulty of interpretation results in a poor semantic encoding of the non-

specific words. Poorly encoded items are difficult to retrieve during delayed repetition. The difficulty of interpretation (and therefore also of semantic encoding) can be a result of two factors: (a) A specific interpretation for these words can be difficult to provide for the subjects and thus they do not interpret these words at all, but rather retain the phonological forms of these words, waiting for more information to come from the rest of the sentence; (b) the subjects interpret these words but it takes them longer to supply a specific interpretation and therefore they often fail to specify the word in the time they have for its processing. In contrast to the non-specific words, the specific words are easy to interpret/encode semantically, and consequently, easy to repeat following the delay.

2. The Specificity X Similarity interaction observed in the Delayed Repetition task is a direct confirmation of the second hypothesis, formulated earlier in this chapter (p.95), which predicted that the effect of phonological interference would be greater for non-specific words than for specific words. The finding of this interaction is just the kind of support for the Phonological Retention hypothesis (Chapter 4) that was sought in the design of the experimental tasks.

3. The Specificity effect in the Cued Recall task can be interpreted similarly to the Specificity effect in the Delayed

Repetition task. It shows that the non-specific words are difficult to interpret and encode and, consequently, recall.

4. The Similarity effect in the Cued Recall task is a direct confirmation of the first of the two hypotheses, formulated earlier in this Chapter (p.95), which predicted that the recall of target nouns will be better in the phonologically dissimilar condition as compared with the phonologically similar condition. The similarity effect shows that the similarity between the subject noun and the verb interferes with the phonological retention and, consequently, with semantic interpretation/integration and encoding. This can be taken to suggest that even the processing of sentences with specific words required a certain amount of phonological retention which was impaired by phonological similarity.

5. The List effect in the Cued Recall task is difficult to interpret. A plausible interpretation is that it is a result of differences in cohesion/integratability of sentences[2], a factor whose importance increased in the time interval between the presentation of sentences and the Cued

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[2]Some of the effects of semantic cohesion differences were controlled by keeping plausibility differences among sentence types small so that they would not reach the level of statistical significance. This, however, still left some degree of variability in plausibility and the related semantic cohesion/integratability factor uncontrolled.

Recall task. Another interpretation of the List effect is that it is a side-effect of the floor effect observed in this task.

6. The interaction of List and Similarity in the Cued Recall task was a result of the fact that an advantage of the dissimilar over similar nouns was observed only in two lists (the two other lists showed no difference). However, this advantage was large enough to create the Similarity main effect. As mentioned earlier the scores in this task were depressed. This might have exaggerated some of the variability in cohesion among sentences and produced the List X Specificity interaction.

In addition to the statistically significant results, some findings resulting from the comparison of these results call for an interpretation.

7. One such finding is the observation that the specificity effect is much stronger in the Cued Recall than in the Delayed Repetition task. This can be explained on the basis of the timing of the two tasks relative to the presentation of the stimuli. The Delayed Repetition task followed the presentation of the stimuli to the subjects only by about 10 sec. On the other hand, the time interval between the presentation and the Cued Recall task was about 5 minutes. The two tasks differed also in terms of the number of

distractors between the presentation and response. In the Delayed Repetition task, the subjects had to recall one sentence and listen to another before they could repeat any of the stimulus sentences. In the Cued Recall, several sentences separated the presentation and the recall of any given sentence. These differences suggest that the participation of the two types of encoding, the phonological and semantic, is not equal in the two tasks. In the Delayed Repetition task, the subjects' performance is assumed to be based both on phonological and semantic encoding; in the Cued Recall task, on the other hand, it is assumed to be based primarily on semantic encoding. These differences between the two tasks account well for the increase in the Specificity effect in Cued Recall. The advantage of the specific words lies in their ease of interpretation/specification. This advantage is most likely to show in the tasks that rely primarily on semantic encoding, such as the Cued Recall task.

8. Another comparison of the basic results that calls for explanation is why there was no observable advantage of the specific words over the non-specific ones in the dissimilar condition on the Delayed Repetition task. This can be explained in terms of the characteristic of this task discussed in the preceding point, namely, that it can be performed by recalling either a semantic or a phonological trace of a word from the working memory. It appears that the

recall of the non-specific words was possible on the basis of the phonological trace alone as long as this trace was not interfered with by phonological similarity, and that this recall was as good as the recall of the specific words.

9. The preceding two interpretations lead to a refining of the interpretation of the Specificity X Similarity interaction described in point 2 above. It appears that the phonological similarity interaction observed in this task was a result of the non-specific words losing their phonological support, on one hand, and of the specific words gaining an additional advantage over the non-specific words, on the other. Since the specific words were repeated better in the similar than in the dissimilar condition, it is possible that the subjects were able to use phonological similarity as a secondary recall cue for these words. The suggestion that the phonological similarity functioned as a distractor for the non-specific words and as an additional cue for the specific ones falls nicely with the Phonological Retention hypothesis: Phonological similarity is a distractor in the lexical interpretation phase but ceases to be one and can even function as an additional recall cue once the word is interpreted. Since the nonspecific words are longer retained in a phonological form, phonological similarity acts for them as a distractor. The specific words, on the other hand, are interpreted more rapidly and become independent of

phonological support sooner; once they have support in semantic encoding, the phonological similarity can be perceived as a separate information and used as an additioanl recall cue.

In summary, the most important finding coming out of this study is that specific words can be easily processed into some semantic interpretation and require less phonological retention than non-specific words. In the case of the specific words, the lexical access and interpretation, i.e., the retrieval of semantic information and the finding of a referent, takes less time than in the case of non-specific words. In processing terms, this implies that specific words are less likely to require phonological buffering than non-specific words. In practice, this means that the meaning of the specific words is less likely to be lost in the course of processing than the meaning of the non-specific words.

Other findings from the main experiment - lexical and syntactic class effects

The lexical and syntactic class results analysis applies only to the Delayed Repetition task results. Here is the summary of the findings (Appendix L):

1. Both the subject and object nouns were repeated better than the verbs: 55 % of subject nouns, 45 % of object nouns, and 32% of verbs were repeated.

2. Overall the subjects were repeated better than the objects. Characteristically, this difference was much smaller for the Nonspecific Similar sentences (only 4% difference) than for any other type of sentence (17%, 23%, and 27% for Nonspecific Dissimilar, Specific Dissimilar, and Specific Similar respectively).

The finding that nouns were overall better repeated than verbs is predictable from the semantics of nouns and has been observed in earlier studies involving recall (Wickens, 1972). The tendency for the nouns to be easier to process than verbs is often attributed to the fact that, on average, nouns are more concrete and more easily imagable than verbs (Paivio, 1981). In terms of the processing view presented in this study, the greater processing ease of nouns relative to verbs can also be explained in terms of their greater specificity. Nouns more frequently than verbs have inter-subjectively verifiable referents, i.e., exhibit "referential specificity" (cf. Chapter 3, p.69). In processing terms it means that even without a preceding scenario-building context, nouns can often be given a specific situational interpretation. Verbs, on the other hand, tend to be aggregates of senses which may be referentially linked to very diverse spatio-temporal situations. The latter is particularly true of the verbs used in the present experiment, which denoted interpersonal attitudes and emotions. Such verbs can denote a relationship

involving two individuals with relatively equal social status and can therefore pose no restriction on the kind of situation denoted in the sentence, contrary to what the nouns do. Verbs of this kind can be expected to carry little referential, scenario-setting information.

It should be noted, however, that once the setting is established and the participants are identified, as is the case within the body of a narrative (a situation drastically different from the sentence processing situation in the Delayed Repetition experiment), the role of verbs as information carriers becomes much more important. While nouns are primarily responsible for topic continuity, verbs are responsible for the changes in the state of topic or, possibly, an introduction of an entirely new topic (Givon, 1983).

The finding that the subject nouns were easier to recall than the object nouns is relatively easy to explain. The subject nouns usually identify the main topic of the sentence. They provide information that is crucial in the setting of the sentence interpretation. The reason why the Nonspecific Similar sentences show least of difference between subject and object recalls is a direct consequence of the effect of specificity (or rather non-specificity in this case) on phonological retention. The nonspecific subjects were

interfered with by the phonologically similar verb while the objects were not.

Although these results appear to be quite robust and are easily interpretable, they have to be approached with a certain degree of caution and cannot be generalized for all nouns and verbs or subjects and objects. The findings reported here were not a result of a planned comparison and the necessary controls were not built into the experimental design to allow a good basis for such generalization.

Other findings - Post-experimental Questionnaire

Following the main experiment, the subjects were asked a few questions about personal information, as well as their experiences during the experimental tasks (for Post-experimental Questionnaire see Appendix M). The personal information recorded was: age, sex, involvement in music, and first language. The questions about the experiment included: the strategy used in memorizing the sentences for repetition (if any), and a series of questions designed to verify whether or not the subject detected the phonological similarity between the words in experimental sentences. The information obtained on the basis of the Questionnaire was used to re-analyze the Delayed Repetition and Cued Recall scores from a new perspective. The statistics describing the results of this

analysis are contained in Appendix N. The remaining sections of this chapter are devoted to the summary of this analysis.

Age

There were 43 subjects in the age group below 25, 7 subjects in age group 25-34, and 6 subjects between 35-45. A comparison of the recall scores obtained in the Delayed Repetition and Cued Recall exeriments was performed between the first group, below 25, and the two remaining groups collapsed together, i.e., above 25. The t-test results showed no significant effect of age either in the Delayed Repetition or in the Cued Recall experiment.

Sex

There were 28 subjects of each sex. A slight tendency favouring males was detected in the results of Delayed Repetition experiment, but this was found to be not significant statistically (not even at $p < .2$) and no such tendency was observed in the Cued Recall experiment.

"Musical ear"

Among the questions asked of subjects there was a series of questions designed to probe the subjects' musical disposition. The subjects were asked about their formal musical education, instruments played, and other forms of involvement with music. Although no strict criteria were set

for classifying the subjects, these questions provided some basis for dividing them up into two general categories of musical aptitude.

This classification allowed to test an "ad hoc" hypothesis that perhaps having a "musical ear" may help the subject to better differentiate the phonologically similar items and avoid the confusion that these items introduce. This hypothesis was formulated based on the results of a pilot study, which seemed to indicate that there may be an effect of musical disposition on delayed repetition. This was found, however, to be irrelevant as no effect of "musical ear" on subjects' performance was found in the Delayed Repetition task. There was a slight tendency for the "musical" subjects to have a better recall in the Cued Recall experiment. However, this tendency did not reach even the $p < .2$ level of significance. There were enough subjects in the two groups differentiated on the basis of musical aptitude to conclude that there is no observable relationship between having a "musical ear" and the performance on the two tasks.

Native vs. non-native knowledge of English

Among the students who volunteered for the experiment there were few fluent non-native speakers. The following observations were made with respect to their performance. The four non-native speakers (7% of all subjects included in the

experiment) who were able to do the Delayed Repetition task performed at a level comparable to native speakers. A few non-native speakers found the task too difficult and had to withdraw from the experiment. However, some individuals among the native-speakers of English also found the task too difficult. Among the subjects who actually completed the task the t-test revealed no significant effect of being a native speaker on the performance in the Delayed Repetition task. In the Cued Recall experiment, there was a slight tendency favouring the native speakers but the result of the t-test was again not significant. It should be noted that the inclusion of non-native speakers in the experiment was not a confounding variable as the experimental design involved repeated measures, with each subject being his or her own control; any major differences in performance between native and non-native speakers were thus counterbalanced.

Strategy

All subjects were asked whether or not they employed any particular strategy to help retain the sentences for later repetition. An overwhelming majority of subjects reported having tried to use some memorization strategy. The most frequently used strategy was repetition of a sentence upon hearing it.

The use of this strategy can be viewed as providing some additional support for the Phonological Retention hypothesis. Although the Specific sentences in the Delayed Repetition experiment were easier than the Non-specific ones, all of the sentences were relatively difficult to interpret, being presented without a context. As it was argued in Chapter 1 (p.9), subvocal rehearsal is closely associated with STM. It is thus not surprising that the subjects in a difficult language processing task like Delayed Repetition relied on a strategy that is developmentally associated with phonological retention.

Other strategies, used less frequently by the subjects, were visualization/forming associations and trying to remember the nouns. There were not enough subjects in the different strategy groups to do statistical tests on the effects of different strategies on repetition/recall performance and no tendency could be observed from the means.

It should be noted that the information on the types of strategies and the frequency of their use was coming from self-reports and is a subject to the limitations of this technique. The reliability of the introspections provided by the subjects is to some extent verified by the fact that several subjects reported using the same strategies.

Detection of phonological similarity

The last series of questions that were asked of each subject probed whether or not he/she detected the phonological similarity between sentences. Only six subjects noticed that there was a phonological similarity between words in some sentences. The number of subjects who detected the similarity was too small to assess by means of a statistical test whether or not the detection of similarity had any effect on their performance. Some of the subjects who were aware of the similarity made interesting comments about the influence of similarity of sound on the processing of a sentence. Although based on subjective insights, these remarks provide some verification that similarity indeed interferes with the initial processing, and that, once processed, the phonologically similar items may be slightly easier to recall. Here are the relevant quotations:

> Sometimes they [words] were starting with the same letter and I had to stop and think about it because if there was ... how is it called ... [alliteration] they would just became sounds. (Subject #33)

> If it was abstract [the first word in the pair] then the second interfered more -- because I was still trying to figure out what the first word meant. (Subject #30)

> There was a lot of repetition of certain sounds -- this confused me. (Subject #37)

> [Alliteration] didn't help [in repetition]; there was too much concentration. It helped in the second task [recall]. (Subject #53)

> Alliteration helped -- was easier to remember because you knew they start with the same letter. (Subject #60)

Additional findings

In addition to the elicited answers, many subjects volunteered other comments about the task. They often commented on the fast pace of the task and a certain feeling of surprise at their inability to recall a sentence they just heard. A number of subjects reported that nouns were usually easier to remember than verbs and that the "common" (non-specific) words were more difficult to remember than the less common ones. Some also noticed that the sentences containing words that were semantically compatible with words from other sentences on the stimulus list interfered with each other at recall; for example "manager" and "owner", each part of a different sentence in the experiment, are semantically compatible with each other and could be part of the same sentence.

CHAPTER 6: IMPLICATIONS OF THE STUDY

This chapter will describe some possible inferences that can be derived from the empirical results reported in Chapter 5 as well as from the theoretical claims advanced in Chapters 2-4.

Re lexical processing models

The lexical processing model presented in Chapter 4 makes an attempt to move away from the current emphasis in lexical processing models on the concepts of word recognition and lexical access, and towards the concept of lexical interpretation. As was argued in Chapter 2, there is a great deal of contextual dependency among lexical items. It is thus unlikely that listeners go about processing words on the basis of a fixed-entry lexicon. Given that most lexical items require some degree of inference before they can be specified, the notion of lexical access is bound to be a simplification of the problem of lexical processing and, it is proposed, should be substituted with a more realistic notion of lexical interpretation.

Re syntactic parsing models

Since the focus of this study is on lexical processing, only very tentative suggestions as to the role of syntax can be given. The view of language comprehension advanced in Chapters 2 and 4 suggested the possibility of inclusion in the

model of language processing direct connections from lexical items to messages. In general, it is assumed that the listener's awareness of the syntactic patterns of the language provides him or her with on-line expectations with respect to two things: the continuation or discontinuation of the message and the dependency relations among the components of the message. Together these two kinds of information allow the processing system to identify the chunks of a message that can be interpreted independently. These expectations can be translated into decisions to process or store the lexical material within the working memory.

The knowledge of syntactic patterns can serve the function of facilitating the processing in working memory. For example, if the knowledge that heads of phrases usually serve as specifiers/disambiguators of their dependents (Keenan, 1978) is built into the processing system, the system can function at its most efficient and economize its resources[1]. The knowledge of a typical structure of a NP, for example, can serve as a basis for the distribution of the resources during processing of that phrase. The processing is likely to be terminated as soon as a lexical item cannot be interpreted as part of the current NP. Such use of resources is highly rational as the possibility that a noun or an adjective in a

[1]The notion that the processing system has to minimize its resources is related to the concept of limited capacity of the working memory (cf. Chapter 1).

NP will be specified by information coming after the closing boundary of this NP is very small.

Re memory models

As the specific/non-specific dimension is highly correlated with the concrete/abstract dimension, the results of this study can be extrapolated to concreteness/abstractness. An explanation of the differences observed in processing between concrete and abstract words can thus be provided. This explanation differs in important ways from another well-known account of the processing effects of concreteness/abstractness: "dual coding" theory of semantic memory, proposed by Paivio (Paivio, 1971, Paivio & Begg, 1981).

The dual coding theory makes an assumption that two separate semantic-memory codes underlie language processing, the verbal and the imagery code. The former is the memory of words, the latter is the memory of images. The advantage of concrete words over abstract ones, observed in processing, is explained in terms of the differences in memory representation. The abstract words are said to rely on the verbal code only. The concrete words, on the other hand, are said to profit from a dual representation based on both the verbal and the imagery code. In sum, the dual coding explanation is based on the assumption of a structural

inequality of representations that distinguishes concrete and abstract vocabulary items.

The explanation proposed here, on the other hand, is a processing explanation. It assumes that the concrete and abstract words are interpreted rather than represented differently. The difference lies not so much in the manner as in the depth, or perhaps, spread of processing. In general, abstract words require more context before they can be interpreted. It is much easier to provide a specific interpretation for a concrete word presented outside of a context than for an abstract word. In an experimental, decontextualized situation the abstract words are at a greater disadvantage than the concrete ones. Since it is more difficult to specify the abstract words outside of the context than it is to specify the concrete ones, the abstract words are encoded more poorly than the concrete words. The poor initial encoding results in poor recall and recognition.

Re comprehension errors

An important implication of the model is that it provides an explanation of the common comprehension errors. It is proposed that a comprehension error can be viewed as a result of an interpretation process that was not completed. Instead, an interim interpretation was adopted as the final interpretation. If every word can be seen as a potential basis

for a hypothesis about the whole sentence message, any imperfection of either the utterance itself or the perception of it may lead to the comprehender being left with only a tentative interpretation of the message. As it is not uncommon to be faced with an utterance which exceeds the listener's current informational or processing level (it is not relevant from the processing point of view whether the fault is on the speaker's or the listener's side), it is very probable that people develop strategies to deal with utterances exceeding their current processing level and often assume the interpretations based on imperfect input or perception as the 'true' interpretations.

Re aphasia

The subjects in the Delayed Repetition experiment, when put in a situation of informational overload, produced a whole range of errors closely resembling in kind the errors normally produced by aphasic individuals. It is an undisputed fact that aphasics' general processing ability is reduced. A similarity between this experiment and the aphasia situation can be observed in that aphasics, given their overall reduced processing capacity due to brain damage, are likely to be in a situation of informational overload most of the time. For them, even slowly delivered speech is likely to produce disproportionately greater comprehension errors than is the case with normal speakers. The similarity between the normal

speech errors and the aphasic productions has been pointed out before by Buckingham (1980). The current study demonstrates how easily informational overload can limit the language processing capacity of normal speakers.

The confirmation of the Phonological Retention hypothesis, which assumes that non-specific words are more likely to require phonological retention in the course of processing than the specific words, has some direct implications for aphasia. If, as was demonstrated by these results, the processing of non-specific words poses greater demands on the phonological retention system, it can be predicted that the former will be more affected when the phonological retention is impaired, as is the case in many aphasics, than the latter. Agrammatic aphasia, in which the processing of some lexical classes is affected more than other classes, provides a unique verification of the Phonological Retention hypothesis. In this type of aphasia (cf. Chapter 1), the processing of lexical classes is impaired, roughly in the folowing order: prepositions, adverbs, adjectives, verbs and nouns. As it happens, these lexical classes can be placed on the continuum of specificity, as defined in Chapter 3, in about the same order. Starting from left to right, the words in these lexical classes are more and more specific (or less and less likely to be contextually dependent.) Consequently, agrammatism can be explained as a result of the deficit of

the phonological retention alone. The reduced STM span has, in fact, been found to be a typical characteristic of these patients (cf. Chapter 1).

Re word order universals

Yet another possible implication of the proposed lexical processing model is that it enables us to predict how processing considerations may influence the word order tendencies in languages of the world. In particular, it allows us to predict what configurations of words in a sentence may be difficult from the point of view of the comprehender. In addition, it allows us to make certain generalizations about the preferred order of occurrence of different types of information in a sentence.

In general, it can be predicted that the words that carry interpretation prerequisites should precede the word or words that are specified. A prior location of the interpretation prerequisites relative to the word that has to be specified makes the interpretation easy while a posterior location makes it difficult: When the interpretation prerequisites of a word are located priorly, i.e., when the contextual dependency of a lexical item is retrogressive, the word can be processed on-line, while if the dependency is progressive, i.e., the

interpretation prerequisites are located in the following context, it has to be processed off-line[2].

One specific processing implication of this is that anaphoras should, in principle, be easier than cataphoras. Since in an anaphora the antecedent precedes the pronominal information, the specifying information should be present in working memory at the time when the pronoun is processed and the resolution of the anaphora should be easy. Conversely, in a cataphora, the specifying information is coming in the following context and the pronoun (or its zero marker) can only be interpreted generally and has to be retained phonologically before it can be further interpreted. The fact that, in the languages of the world, cataphora is relatively less common than anaphora[3] could be attributed to its expected greater processing difficulty.

Another prediction which can be derived from the proposed model of lexical processing is that comprehension should be easier when the prerequisite and the word specified are

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[2]It should be noted that this generalization should not be taken to suggest that the specifying word should always precede the one to be specified. Within the limits of a phrase, the situation where the specifier precedes the specified may have a minimal effect on processing.

[3]The typological observations mentioned in this section are based on my work between 1985-1987 in a research project on statistical word order universals under the leadership of M.S. Dryer. The specific facts were later confirmed in a personal communication with M.S. Dryer (May, 1989).

located close to each other in a sentence. This prediction is based on what is known about the limited capacity of working memory (cf. Chapter 1). If an interpretation process has to be based on two separate words, the information recovered from the first may be lost before the information from the second is recovered. The most desirable appears to be a situation when the two words are adjacent members of the same syntactic phrase. In such a situation the progressive contextual dependency may be least harmful. (In English, in fact, this is very common since, within the limits of a phrase, a non-specific, polysemous word often precedes the word which is setting the reference for that phrase; i.e., adpositions are preposed, verbs precede objects, adjectives precede nouns, and adverbs precede verbs.)

In addition to the predictions about the relative order and distance constraints between the specifier and the specified, some predictions about the preferred order of delivery of certain kinds of information within a sentence can be formulated.

One such prediction stems from the importance of the information about the functional domain in the interpretation of the individual lexical items. It can be predicted that the information about the location of the event referred to in a sentence should be placed early in the sentence, given that

it plays an important role in the identification of the functional domain. A tendency to place locatives early in the sentence can be observed in, at least, some languages[4]. Whether this is, in fact, the case in most languages would have to be further investigated.

In addition to the information referring to location, the information about the time of the event referred to in the utterance can be clearly related to the notion of specification. Because of its importance in the identification of a set of possible referents, the temporal information can also be expected to be preferably placed early in the sentence. By indicating the temporal information early in the utterance, the speaker helps the listener to identify a broad domain of possible referents. The tendency to place elements of the sentence bearing some temporal reference in the initial position seems to be well established: Temporal adverbials are the only thing other than subjects that very commonly occur in initial position. Many grammars describe initial position as the usual position for temporal adverbials[5].

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[4]See footnote 3.

[5]See footnote 3.

SUMMARY AND CONCLUSIONS

The most important contribution of the thesis, from the perspective of the original objectives, is the testing and verification of the Phonological Retention hypothesis, which assumed that phonological retention plays a special role in the processing of the contextually dependent, non-specific lexical items. For the purposes of the experimental study the main hypothesis was divided into two experimental hypotheses, each reflecting one aspect of the Phonological Retention hypothesis. The results were found to be statistically significant for both experimental hypotheses, providing strong support for the theoretical claim about the role of phonological retention in lexical processing.

The experiment was based on two tasks: a Delayed Repetition task and a Cued Recall task. The construction and testing of the Delayed Repetition task, in particular, can itself count as a contribution, as this task proved to be very effective in providing insight into the on-line lexical interpretation processes. The Cued Recall task produced additional information about the persistence of the specificity effect over time. Two other tasks, metalinguistic in nature, had to be designed in order to control the lexical and sentential material used in the testing of the hypotheses. These were Specificity Judgments and Plausibility Ratings.

A separate contribution of the study is the defining of the lexical-semantic variable of specificity, which is the ability of a lexical item to convey information -- i.e., to be interpreted independently of context. This variable, it was argued, is responsible for the high correlations found between many previously defined lexical-semantic variables, such as polysemy/ambiguity, superordinateness/generality, vagueness, concreteness, imagability, and meaningfulness. In addition to providing the semantic arguments for specificity as a global lexicon-spanning variable, its value was also argued for on psycholinguistic grounds. In particular, it was shown that specificity is closely related to a processing variable of ease-of-interpretation or interpretability.

In addition to the above, a number of secondary issues motivated the study and were addressed. These were: (a) to provide an explanation of the differences between the "concrete" and "abstract" understanding; (b) to find a method of description of the failures in language comprehension that is not based on individual differences; (c) to provide an explanation of agrammatic aphasia; (d) to promote a greater use of metalinguistic tasks drawing upon native speakers awareness of their language as an important source of psycholinguistic data.

In the course of defining the experimental variables and formulating the hypotheses for the experimental part of the study, a number of ideas about the process of comprehension were developed, which should aid future research. In the context of describing a view of language comprehension that provides the background for the Phonological Retention hypothesis, the concept of the interpretation prerequisite was formulated. This concept is a useful tool in describing the meaning interaction between any two lexical items co-occurring in an utterance. A word can be said to be an interpretation prerequisite of another, if its interpretation should precede the interpretation of the other.

Another useful proposal addresses the current theories of lexical process_ng. The concept of lexical access, which assumes the existence of a fixed-entry lexicon, and is a commonly used concept in lexical processing, could profitably be substituted with the concept of lexical interpretation, which does not make any assumptions about the structure of the mental lexicon.

It was further suggested that the interpretation of an utterance can be viewed as an accumulative process in which every word can be the source of the message-level interpretation. Consequently, some form of the final sentence interpretation can be reached very early in the course of

processing a sentence. This cumulative process of sentence interpretation was referred to as "stepwise interpretation," where each word constitutes a single step of interpretation.

Finally, it was proposed that the lexicon can be viewed as an indexing/retrieval system used in accessing world knowledge specific to a given socio-cultural group, rather than a separate system onto itself.

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Appendix A

Specificity Judgments - Response Form (A-1)

	Specific (few scenarios or settings)	Non-specific (many scenarios or settings)
spectator		
acrobat		
balloonist		
witness		
chaplain		
rabbi		
beginner		
dispatcher		
champion		
associate		
bartender		
diskjockey		
foreigner		
passerby		
mountaineer		
forester		
hostess		
grocer		
patron		

Appendix B

Specificity Judgments - Instructions

The English language has a very rich vocabulary. Different words have different meanings. Some words are specific, others are not. The word "astronaut", for example, has a specific meaning while the word "consultant" does not. The "astronaut" is always associated with one area of human activity -- space exploration. The word "consultant" can be associated with different scenarios or settings since there can be different kinds of consultants: family, financial, computing.

The lexical material listed below will be used in a psycholinguistic experiment. In order to control for the differences between words we have to know which words are specific and which are not and that is why we need your help.

This is what you are asked to do: Consider separately each of the words listed on the next page and for each word decide whether you think it is specific or not. (Make a decision for each word, even if you are not 100% sure.) Mark your asnwer by checking the appropriate column: left column if you think the word is specific, and right column if you think it is not. (If you have any comments that occurred to you while doing this task please use the spare page at the back of the questionnaire.) Thank you!

Appendix C

Delayed Repetition - Instructions

This experiment deals with linguistic memory. In particular, we are interested to know how well people can remember sentences.

You will hear a series of sentences. I want you to wait until you have heard the second sentence. There will be a pause of about 4 sec. This is when you are asked to repeat the first sentence you heard. After you have heard the third, repeat the second, and so on until the end of the list.

In general, you are asked to repeat sentences with one sentence delay.

If you are unable to repeat the whole sentence repeat whatever you remember of it. You may substitute the expressions "someone" or "something" for the missing words. If you have lost a sentence completely always wait two sentences before you start repeating again.

There will be 10 training sentences and around 35 sentences of the actual task. The training sentences are a little easier than the test sentences. In general, this type of task requires a lot of concentration.

Thank you very much for your cooperation.

Appendix D

Cued Recall - Response Form

Here are fragments of some of the sentences from the previous task. Fill in the missing words.

The _____ believed the pilot.

The _____ rewarded the children.

The _____ challenged the mayor.

The _____ supported the director.

The _____ greeted the neighbour.

The _____ convinced the writer.

The _____ detested the owner.

The _____ protected the teenager.

The _____ recognized the swimmer.

The _____ accused the senator.

The _____ troubled the police.

The _____ encouraged the buyer.

The _____ startled the waitress.

The _____ frightened the camper.

The _____ convinced the journalist.

The _____ surprised the warden.

Appendix E

List 1

F: The hunter escorted the explorer.
F: The dancer sheltered the hippie.
F: The doctor examined the diver.
NS: The beginner believed the pilot.
F: The soldier photographed the tourist.
ND: The volunteer rewarded the children.
F: The florist criticized the helper.
SS: The chaplain challenged the mayor.
F: The cyclist awaited the jogger.
SD: The musician supported the director.
F: The mailman notified the farmer.
NS: The grower greeted the neighbour.
F: The plumber annoyed the operator.
ND: The manager convinced the writer.
F: The dealer visited the banker.
SS: The diskjockey detested the owner.
F: The admiral dated the singer.
SD: The schoolmaster protected the teenager.
F: The vender angered the houskeeper.
NS: The resident recognized the swimmer.
F: The caretaker cheated the landlord.
ND: The delegate accused the senator.
F: The librarian advised the reader.
SS: The trapper troubled the police.
F: The partisan worshipped the leader.
SD: The architect encouraged the buyer.
F: The seamstress avoided the model.

Appendix E (cont.)

List 2

F: The hunter escorted the explorer.
F: The dancer sheltered the hippie.
F: The doctor examined the diver.
ND: The spectator believed the pilot.
F: The soldier photographed the tourist.
SS: The reporter rewarded the children.
F: The florist criticized the helper.
SD: The rabbi challenged the mayor.
F: The cyclist awaited the jogger.
NS: The substitute supported the director.
F: The mailman notified the farmer.
ND: The hostess greeted the neighbour.
F: The plumber annoyed the operator.
SS: The composer convinced the writer.
F: The dealer visited the banker.
SD: The bartender detested the owner.
F: The admiral dated the singer.
NS: The producer protected the teenager.
F: The vender angered the houskeeper.
ND: The attendant recognized the swimmer.
F: The caretaker cheated the landlord.
SS: The accountant accused the senator.
F: The librarian advised the reader.
SD: The burglar troubled the police.
F: The partisan worshipped the leader.
NS: The informer encouraged the buyer.
F: The seamstress avoided the model.

Appendix E (cont.)

List 3

F: The hunter escorted the explorer.
F: The dancer sheltered the hippie.
F: The doctor examined the diver.
SS: The balloonist believed the pilot.
F: The soldier photographed the tourist.
SD: The hygenist rewarded the children.
F: The florist criticized the helper.
NS: The champion challenged the mayor.
F: The cyclist awaited the jogger.
ND: The laborer supported the director.
F: The mailman notified the farmer.
SS: The grocer greeted the neighbour.
F: The plumber annoyed the operator.
SD: The editor convinced the writer.
F: The dealer visited the banker.
NS: The dispatcher detested the owner.
F: The admiral dated the singer.
ND: The councillor protected the teenager.
F: The vender angered the houskeeper.
SS: The referee recognized the swimmer.
F: The caretaker cheated the landlord.
SD: The governor accused the senator.
F: The librarian advised the reader.
NS: The trainee troubled the police.
F: The partisan worshipped the leader.
ND: The technician encouraged the buyer.
F: The seamstress avoided the model.

Appendix E (cont.)

List 4

F: The hunter escorted the explorer.
F: The dancer sheltered the hippie.
F: The doctor examined the diver.
SD: The acrobat believed the pilot.
F: The soldier photographed the tourist.
NS: The researcher rewarded the children.
F: The florist criticized the helper.
ND: The witness challenged the mayor.
F: The cyclist awaited the jogger.
SS: The soprano supported the director.
F: The mailman notified the farmer.
SD: The baker greeted the neighbour.
F: The plumber annoyed the operator.
NS: The companion convinced the writer.
F: The dealer visited the banker.
ND: The assistant detested the owner.
F: The admiral dated the singer.
SS: The principal protected the teenager.
F: The vender angered the houskeeper.
SD: The ferryman recognized the swimmer.
F: The caretaker cheated the landlord.
NS: The acquiantance accused the senator.
F: The librarian advised the reader.
ND: The elder troubled the police.
F: The partisan worshipped the leader.
SS: The engraver encouraged the buyer.
F: The seamstress avoided the model.

Appendix F

Plausibility Ratings - Response Form (List 1)

The hunter escorted the explorer.

1 2 3 4 5 6 7
very implausible — very plausible

The dancer sheltered the hippie.

1 2 3 4 5 6 7
very implausible — very plausible

The doctor examined the diver.

1 2 3 4 5 6 7
very implausible — very plausible

The beginner believed the pilot.

1 2 3 4 5 6 7
very implausible — very plausible

The soldier photographed the tourist

1 2 3 4 5 6 7
very implausible — very plausible

The volunteer rewarded the children.

1 2 3 4 5 6 7
very implausible — very plausible

The florist criticized the helper.

1 2 3 4 5 6 7
very implausible — very plausible

The chaplain challenged the mayor.

1 2 3 4 5 6 7
very implausible — very plausible

Appendix F (cont.)

The cyclist awaited the jogger.

1	2	3	4	5	6	7
very implausible						very plausible

The musician supported the director.

1	2	3	4	5	6	7
very implausible						very plausible

The mailman notified the farmer.

1	2	3	4	5	6	7
very implausible						very plausible

The grower greeted the neighbour.

1	2	3	4	5	6	7
very implausible						very plausible

The plumber annoyed the operator.

1	2	3	4	5	6	7
very implausible						very plausible

The manager convinced the writer.

1	2	3	4	5	6	7
very implausible						very plausible

The dealer visited the banker.

1	2	3	4	5	6	7
very implausible						very plausible

The diskjockey detested the owner.

1	2	3	4	5	6	7
very implausible						very plausible

Appendix F (cont.)

The admiral dated the singer.

1 2 3 4 5 6 7
very very
implausible plausible

The schoolmaster protected the teenager.

1 2 3 4 5 6 7
very very
implausible plausible

The vender angered the houskeeper.

1 2 3 4 5 6 7
very very
implausible plausible

The resident recognized the swimmer.

1 2 3 4 5 6 7
very very
implausible plausible

The caretaker cheated the landlord.

1 2 3 4 5 6 7
very very
implausible plausible

The delegate accused the senator.

1 2 3 4 5 6 7
very very
implausible plausible

The librarian advised the reader.

1 2 3 4 5 6 7
very very
implausible plausible

The trapper troubled the police.

1 2 3 4 5 6 7
very very
implausible plausible

Appendix F (cont.)

The partisan worshipped the leader.

1 2 3 4 5 6 7
very very
implausible plausible

The architect encouraged the buyer.

1 2 3 4 5 6 7
very very
implausible plausible

The seamstress avoided the model.

1 2 3 4 5 6 7
very very
implausible plausible

The staffer startled the waitress.

1 2 3 4 5 6 7
very very
implausible plausible

The guitarist favoured the drummer.

1 2 3 4 5 6 7
very very
implausible plausible

The passerby frightened the camper.

1 2 3 4 5 6 7
very very
implausible plausible

The therapist cautioned the athelete.

1 2 3 4 5 6 7
very very
implausible plausible

Appendix G

Plausibility Ratings - Instructions

Please check the information that is true of you:

1. English is my first language YES _____ NO _____

2. Male _____ Female _____

The purpose of this study is to collect plausibility judgments for a set of English sentences. The plausibility of a sentence depends on the ordinariness or likelihood of the event described by it. Thus a plausible sentence will describe a very ordinary event which has a high probability of occurring in everyday life, whereas an implausible sentence will describe a very bizarre or unexpected event which is not very likely to occur. Choose rating 7 if you think that a sentence is very plausible and rating 1 when you think that it is very implausible. Assign the middle values if you think that the event is neither very plausible nor very implausible. For example, the sentences "The teacher helped the student" or "The child loved her mother" are highly plausible. On the other hand, the sentences "The scuba-diver invited the queen" or "The stranger signalled the astronaut" are very implausible.

Don't spend too much time on any given item. Rely on your first impressions. Do not skip sentences. Give a rating to every sentence even if you are not sure. There will be 8 practice sentences and then 35 sentences of the actual task.

Thank you for your cooperation!

Appendix H

Analyses of Variance

a. Delayed Repetition

Source	SS	df	MS	F	
1. SPEC	4.290	1	4.290	[1/9]	7.162**
2. SIM	0.040	1	0.040	[2/10]	0.057
3. SPECxSIM	3.254	1	3.254	[3/11]	4.551*
4. LIST	4.906	3	1.635	[4/8]	1.134
5. LISTxSPEC	1.335	3	0.445	[5/9]	0.743
6. LISTxSIM	3.085	3	1.028	[6/10]	1.460
7. LISTxSPECxSIM	4.299	3	1.433	[7/11]	2.004
8. SUBJ(LIST)	74.982	52	1.442		
9. SPECxSUBJ(LIST)	31.125	52	0.599		
10. SIMxSUBJ(LIST)	36.625	52	0.704		
11. SPECxSIMx SUBJ(LIST)	37.196	52	0.715		

* $p < .05$

** $p < .025$

Appendix H (cont.)

b. Cued Recall

Source	SS	df	MS	F	
1. SPEC	9.040	1	9.040	[1/9]	23.789***
2. SIM	2.790	1	2.790	[2/10]	5.558**
3. SPECxSIM	0.112	1	0.112	[3/11]	0.365
4. LIST	6.228	3	2.076	[4/8]	2.879*
5. LISTxSPEC	2.942	3	0.981	[5/9]	2.582
6. LISTxSIM	6.835	3	2.278	[6/10]	4.538**
7. LISTxSPECxSIM	0.656	3	0.219	[7/11]	0.713
8. SUBJ(LIST)	37.482	52	0.721		
9. SPECxSUBJ(LIST)	19.768	52	0.380		
10. SIMxSUBJ(LIST)	26.125	52	0.502		
11. SPECxSIMx SUBJ(LIST)	15.982	52	0.307		

* $p < .05$

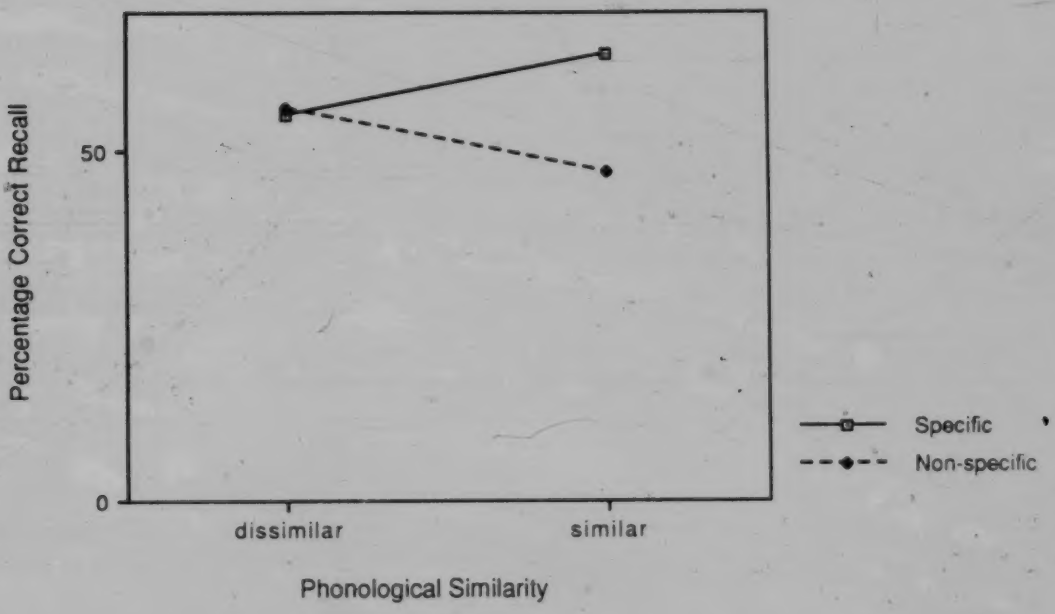
** $p < .025$

*** $p < .005$

Appendix I

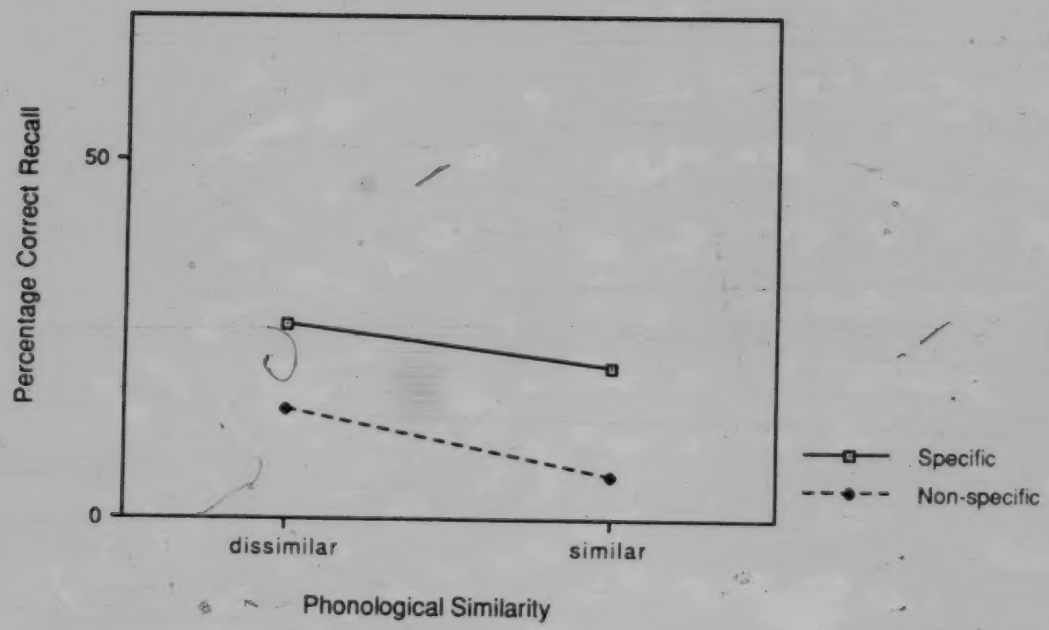
Main Results

a. Delayed Repetition



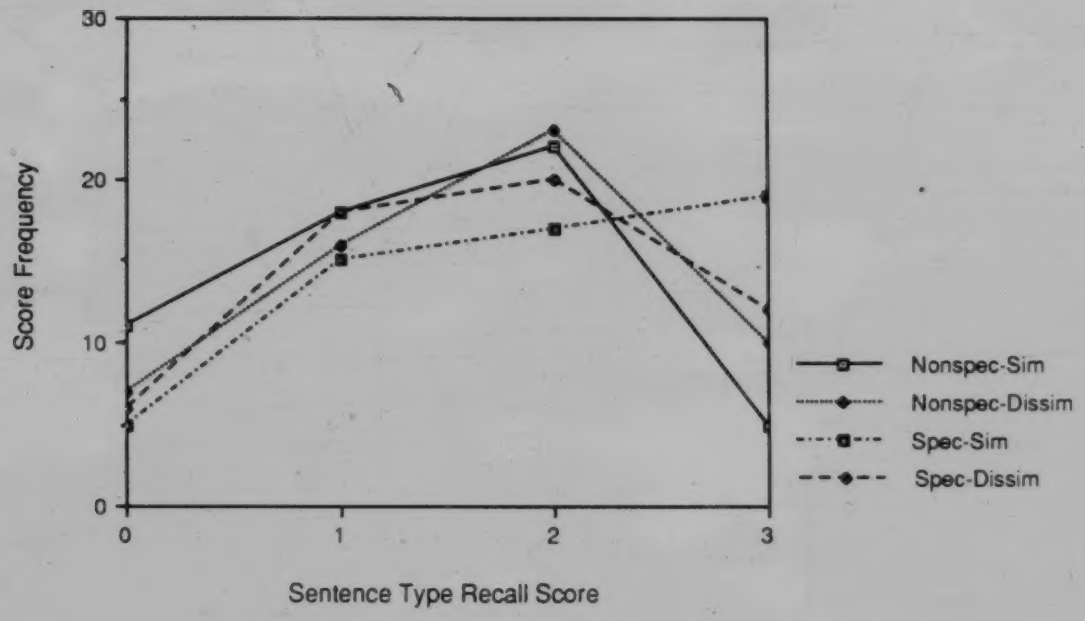
Appendix I (cont.)

b. Cued Recall



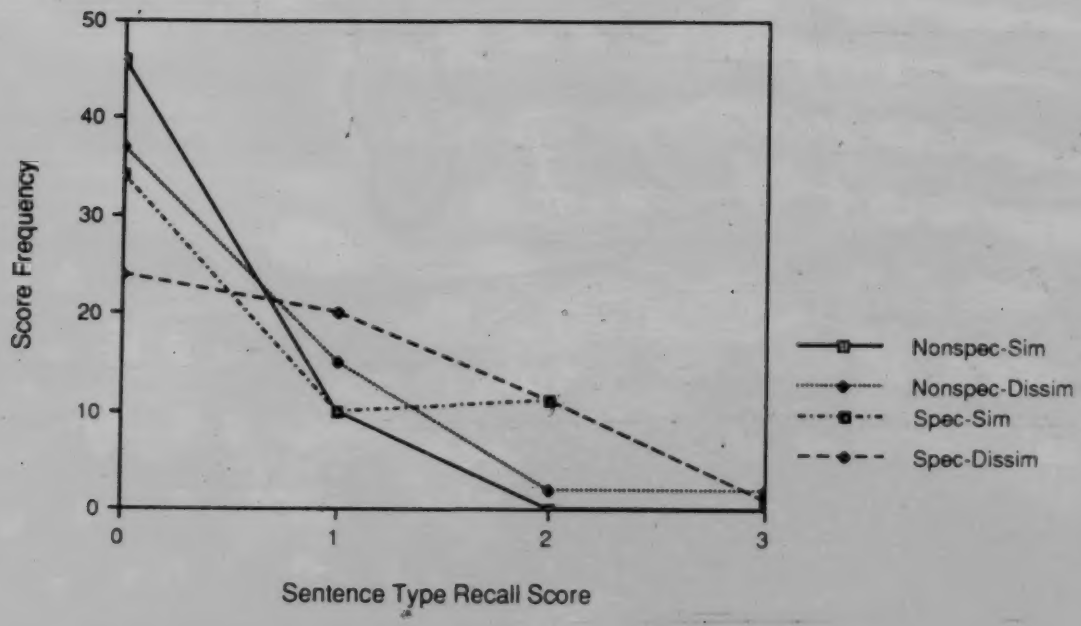
Appendix J

Delayed Repetition - Distribution of Scores



Appendix K

Cued Recall - Distribution of Scores



Appendix L

Delayed Repetition - Lexical and Syntactic Class Totals

a. Broken down by types:

	Nonspecific-Similar			Nonspecific-Dissimilar			Specific-Similar			Specific-Dissimilar		
	S	V	O	S	V	O	S	V	O	S	V	O
	77	68	74	92	66	78	106	75	78	94	71	70
%	46	40	44	55	39	46	63	45	46	56	42	42

b. Totalled across types:

	S	V	O
	369	212	300
%	55	32	45

Note: S = Subject, V = Verb, O = Object

Appendix M

Post-experimental Questionnaire

Male___ Female___

Age range:

below 25___ 25-35___ 35-45___ 45-55___ 55-65___

Have you taken any music lessons/courses or have played a musical instrument? Yes___ No___

Is English your first language? Yes___ No___

Re: Repetition Task

What kind of problems have you encountered in this task?

Do you have any ideas how you were able to remember these sentences?

Have you noticed any kind of relationship between the words in those sentences?

Re: Recall Task

Did you have any special recall method in this task?

Appendix N

Post-experimental Questionnaire - Results

a. Age

	N	Repetition mean	Cued Recall mean
below 25	43	6.8	2.2
25 - 35	7	5.7	1.6
36 - 45	6	6.0	1.7

b. Sex

	N	Repetition mean	Cued Recall mean
male	28	6.9	2.1
female	28	6.3	2.1

Appendix N (cont.)

c. "Musical ear"

	N	Repetition mean	Cued Recall mean
"musical"	23	6.6	2.4
"non-musical"	33	6.6	1.9

d. Native vs. non-native speakers

	N	Repetition mean	Cued Recall mean
native	52	6.7	2.23
non-native	4	5.5	0.25

Appendix N (cont.)

e. Strategy

	N	Repetition mean	Cued Recall mean
repeat	26	6.9	2.1
visualize/ associate	10	6.7	2.3
memorize nouns	10	7	2.0
other	2	5	0.5
no strategy	8	5.4	2.25

f. Detection of phonological similarity

	N	Repetition mean	Cued Recall mean
detection	6	7.7	2.2
no detection	50	6.5	2.1